BANISTERIA

A JOURNAL DEVOTED TO THE NATURAL HISTORY OF VIRGINIA

Northeastern Beach Tiger Beetle
(*Habroscelimorpha dorsalis dorsalis*)

The results of a comprehensive survey for this federally and state threatened insect along Chesapeake Bay beaches on the Eastern Shore of Virginia are presented in the lead article of this issue.

Number 48 ISSN 1066-0712 2017

B A N I S T E R I A

A JOURNAL DEVOTED TO THE NATURAL HISTORY OF VIRGINIA

ISSN 1066-0712

Published by the Virginia Natural History Society

The Virginia Natural History Society (VNHS) is a nonprofit organization dedicated to the dissemination of scientific information on all aspects of natural history in the Commonwealth of Virginia, including botany, zoology, ecology, archeology, anthropology, paleontology, geology, geography, and climatology. Membership in VNHS includes a subscription to *Banisteria*. Annual dues are $20.00 (per calendar year); library subscriptions to *Banisteria* are $40.00. Subscribers/members outside the United States should add $3.00 for additional postage. **Checks or money orders should be made payable to the Virginia Natural History Society**. Membership dues and inquiries should be directed to the Secretary-Treasurer (address, page 2); correspondence regarding *Banisteria* to the Editor. *Banisteria* is a peer-reviewed journal. The Editor will consider manuscripts on any aspect of natural history in Virginia or neighboring states if the information concerns a species native to Virginia or the topic is directly related to regional natural history (as defined above). Biographies and historical accounts of relevance to natural history in Virginia also are suitable for publication in *Banisteria*. For additional information regarding the VNHS, including other membership categories, field events, symposia, pdf copies of papers from past issues of *Banisteria*, and instructions for prospective authors, consult our website at: **http://virginianaturalhistorysociety.com/**

Banisteria No. 47 was published on 6 February 2017.

Cover: *Habroscelimorpha dorsalis dorsalis* (Say), Northeastern Beach Tiger Beetle; photograph by Kevin Fielding.

Back cover: *Pogonia ophioglossoides* (L.) Ker-Gawl., Rose Pogonia or Snakemouth Orchid; original drawing by John Banister, sent to Bishop D. H. Compton in 1689. Figure 44 in folio in Sir Hans Sloane's MS 4002 in the British Museum. Photocopy courtesy of Joseph and Nesta Ewan.

BANISTERIA

A JOURNAL DEVOTED TO THE NATURAL HISTORY OF VIRGINIA

Number 48, 2017

Contributed Papers

Shorter Contributions

Historical Contributions

Miscellanea

Virginia Natural History Society
Officers, 2017

President

Alfred L. Gardner
United States Geological Survey
Patuxent Wildlife Research Center
Smithsonian Institution
P.O. Box 37012, MRC 111
Washington, DC 20013-7012
gardnera@si.edu
(term expires December, 2018)

Vice President

Nancy Moncrief
Virginia Museum of Natural History
Martinsville, Virginia 24112
(term expires December, 2018)

Secretary-Treasurer

Rachel M. Goodman
Department of Biology
Hampden-Sydney College
Hampden-Sydney, Virginia 23943
rgoodman@hsc.edu
(term expires December, 2020)

Councilors

Paul Marek, Blacksburg (term expires December, 2017)
Chris Milensky, Springfield (term expires December, 2018)
Kal Ivanov, Martinsville (term expires December, 2020)

Webmaster

John White (resigned October, 2017)

***Banisteria*, Editor**

Steven M. Roble
steve.roble@dcr.virginia.gov

Honorary Councilors

Michael Kosztarab, Joseph C. Mitchell

Banisteria, Number 48, pages 3-8

Distribution and Abundance of the Northeastern Beach Tiger Beetle (*Habroscelimorpha dorsalis dorsalis*) (Coleoptera: Cicindelidae) at Eastern Shore of Virginia Sites in 2016

C. Barry Knisley

1510 Beaverdam Creek Road
Crozier, Virginia 23039

ABSTRACT

A survey to determine the distribution and abundance of *Habroscelimorpha dorsalis dorsalis* (Say) at all known and potential sites on Virginia's Eastern Shore was conducted during their peak activity time in the summer of 2016 using the visual index count method. The survey found 25,844 adults at 35 sites. This compares with previous counts of 46,082 at 31 sites in 2009, 38,546 in 2005, 33,469 in 2002, and 32,143 in 1999. The decline in 2016 was a result of many of the sites having larger numbers in previous years and some other sites having lower counts. Sites with significantly lower counts were Church Neck North, Savage Neck, Tankards Beach, Scarborough Neck, Occohannock Neck, Parkers Marsh, and Hyslop Marsh. The only sites with significant increases from 2009 were Cape Charles South, Wilkins Beach, and Smith Beach. One new site was found in 2016, Hungars Beach with 125 adults. The causes of the significant decline in 2016 are uncertain, although shoreline recession as indicated by narrower beaches at numerous sites is believed to be a primary factor. Shoreline structures have been added at a number of sites and were associated with declines at some of these, but most of these sites also had low counts prior to 2009. It is uncertain if 2016 indicates a trend of decline or simply a low abundance year that might be followed by a rebound. Year-to-year variation in abundance is typical for this and other species of tiger beetles, and several years of significantly lower numbers like that observed in 2016 are needed to confirm a trend of decline.

Key words: conservation, shoreline armoring, shoreline recession, tiger beetles.

INTRODUCTION

Habroscelimorpha (= *Cicindela*) *dorsalis dorsalis* (Say) was listed as a Federally threatened species in 1990 because of the loss of the Northeastern populations (New Jersey to Massachusetts) and the current threats and lack of protection for many Chesapeake Bay sites (USFWS, 1994). Most significant was the loss of all known sites in New Jersey, New York (especially Long Island), Connecticut, and Rhode Island. The only current New England populations are one on Martha's Vineyard and another at Monomoy National Wildlife Refuge, the latter recently established by translocating larvae from the former. Since federal listing there have been increased surveys for new populations and monitoring of existing populations, most regularly in Maryland where the Calvert County populations have been surveyed every year since 1988. Currently, this beetle is widely distributed and relatively abundant along both shores of the Chesapeake Bay in Virginia and three sites in Maryland (Knisley et al., 2016).

Earlier surveys of *H. d. dorsalis* in Virginia were conducted by the Virginia Department of Conservation and Recreation (Division of Natural Heritage) in 1989-1990 (Buhlmann & Pague, 1992). These surveys discovered many new sites along the eastern and western shorelines of the Chesapeake Bay, but population estimates were not accurate for some sites because they were not fully surveyed. Also, some portions of the Bay shoreline with potential habitat were not surveyed. Results from these and several other earlier surveys were included in the Northeastern Beach Tiger Beetle Recovery Plan (USFWS, 1994). Other survey results for selected sites are in Hill & Knisley (1994), Clark (1997), and Knisley (1997). Roble (1996) compiled the results of all of these earlier reports and some additional records through 1996. His report also includes a list of some potential sites that had not been surveyed.

Complete surveys of all known and potential new Virginia sites were initiated by the U. S. Fish and Wildlife Service in 1998 and continued at various intervals through 2016. The results of this survey of all sites along the western shoreline of the Chesapeake Bay are in Knisley et al. (1998). Results of surveys at all Maryland and Virginia sites through 2015 and the possible factors causing the trends are detailed in Knisley et al. (2016). This paper presents the results of adult surveys of all known Virginia Eastern Shore *H. d. dorsalis* sites in 2016 and is the first complete survey of this area since 2009 (Knisley, 2009). Comparison of these results with previous surveys and a discussion of factors that may explain these recent results are included.

METHODS

Two sites included in this study (Tangier Island and Saxis) were surveyed in July 2015, but all others were surveyed from 27 June to 18 July 2016. These dates are within the known period of peak seasonal activity for *H. d. dorsalis*. Weather conditions were favorable to optimal (sunny, temperatures 27 ºC or higher, and light winds) on all survey days except one when a late afternoon developing storm and cooler temperatures occurred at one survey site. This site (Church Neck North) was resurveyed several days later. Surveys were conducted between 0930 and 1700 h and at low to mid-tide levels for most sites. Overall, survey conditions were appropriate for a high level of adult activity and peak abundance at the sites. The sites south of Elliotts Creek were accessed by land, all others by boat.

I conducted all surveys by walking the length of the shoreline at each site, looking ahead 10-15 m on the sand surface and counting all adult beetles seen within separate shoreline sections, most of which were several hundred meters in length. At sites where beetles were especially dense, I counted numbers as groups of 5 or 10 individuals. Total numbers per section were added to provide a total count for each site. Beach width and other shoreline or back beach features, including shoreline armoring structures for each of the sections surveyed, are not included here but are given in Knisley (2016) and Knisley et al. (2016). The survey results are discussed below and included in Table 1 and site locations provided in Fig. 1.

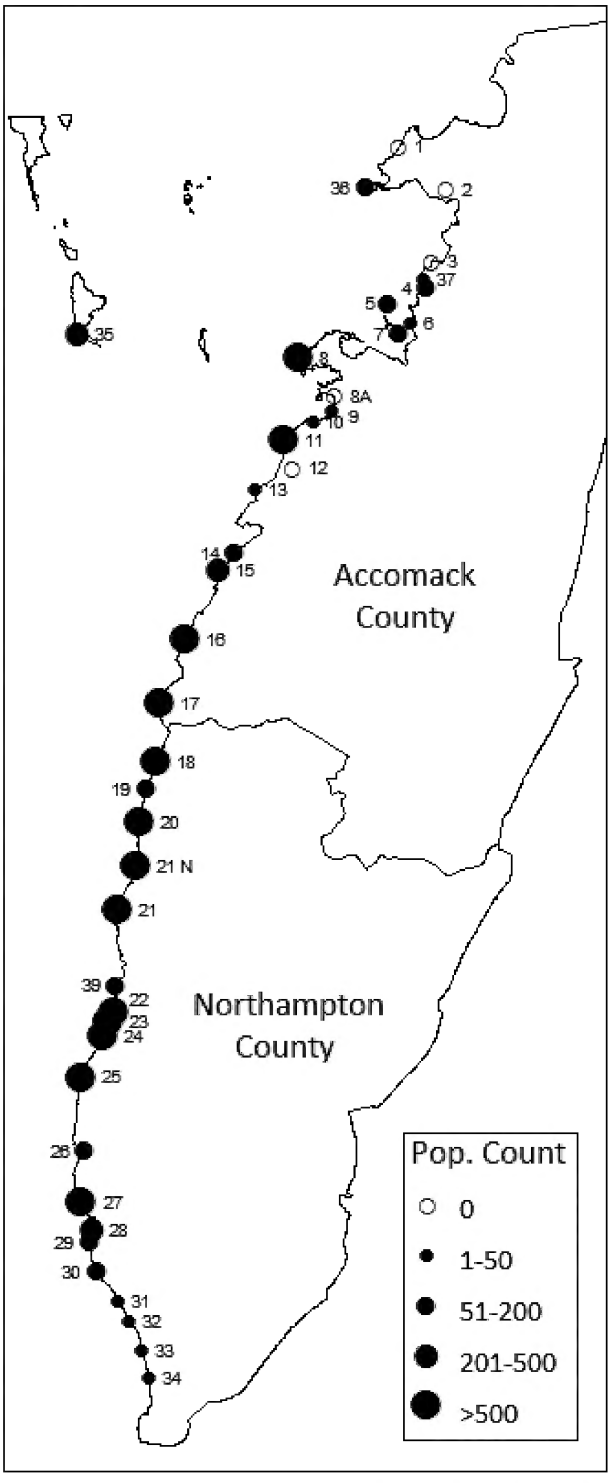


Fig. 1. Map showing all sites surveyed for *Habroscelimorpha d. dorsalis* on the Eastern Shore of Virginia in 2016. Solid dots indicate sites with one or more adults; open circles are sites with no adults.

RESULTS AND DISCUSSION

Overall Trends

The total count of adult *H. d. dorsalis* along the Virginia Eastern Shore in 2016 was 25,844 at 35 sites. This compares with the other complete survey totals of 46,082 at 31 sites in 2009, 38,546 at 35 sites in 2005, 33,469 at 33 sites in 2002, and 32,143 at 35 sites in 1999. The high count in 2009 was due to significant increases in several of the larger sites. In contrast, many of these same large sites and many others had lower counts in 2016, thus producing a lower total. Significantly lower counts in 2016 compared to 2009 were: Church Neck North (1,745 versus 7,979), Savage Neck (6,948 versus 9,657), Tankards Beach (2,270 versus 5,107), Scarborough Neck (2,705 versus 4,087), Occohannock Neck (1,013 versus 2,606), Parkers Marsh (767 versus 1,629), and Hyslop Marsh (898 versus 2,988). The only significant increases from 2009 were Cape Charles South (696 versus 194), Wilkins Beach (510 versus 59), and Smith Beach (632 versus 390). I found one new site in 2016, Hungars Beach with 125 adults.

Accounts of Individual Sites

Northernmost sites (1-9, 36, 37)

This group of natural, unarmored sites is comprised of small, marsh, and fragmentary beaches with relatively low numbers of *H. d. dorsalis*. None has any development activity and little or no apparent human impact except limited use by boaters. The total count for all nine sites was 1,354 compared to the second highest count of 1,664 in 2002 and a low of 449 in 2005. The northern range limit for *H. d. dorsalis* in the Chesapeake Bay is just to the north at Cedar and Janes Islands, Maryland where large populations are found on much larger marsh beaches. Saxis had small numbers of adults in 1999 and 2002 on a short, narrow beach section but none since. A 2015 larval survey that I conducted at this site yielded no larvae of *H. d. dorsalis* or even *Cicindela hirticollis* Say, this latter species being one that is much more tolerant of beach site disturbances. The beach was narrow (1-3 m) with very coarse sand and determined to be unsuitable for adults or larvae. There has also been erosion and beach narrowing in recent years. Long Point East had numbers (199) similar to the past two surveys but much lower than the nearly 600 in 2002. The south-facing shoreline where all of the beetles were found had very coarse sand indicating apparent significant erosion. Most adults were on the wider east beach section. Two sites in this section had significantly higher numbers than in most previous years. Webb Island had 138 adults compared to only five in 1999 and none in other years. Beach Island had the highest ever count of 766 (261 on the south island) along the long, irregular sandy shoreline. The north part of the north island, with a count of 505 adults, had a relatively wide beach with fine sand and evidence of accretion at its north end. Simpson Point had only nine adults compared to five in 2009, and a peak of 378 in 2002. The decline may have been due to the observed shoreline narrowing. Tobacco Island, a new survey site, had no adults.

Table 1. Adult counts for *Habroscelimorpha d. dorsalis* at all Eastern Shore of Virginia survey sites in 2016 and previous years of complete surveys. Blank cells indicate no survey was conducted.

Site #	Site Name	2016	2009	2005	2004	2002	1999
1	Saxis Island	0	0	0		11	136
36	Long Point East	199	74	140		598	
2	Messongo Creek		0	4		0	418
37	Simpson Point	9	5	122		378	
3	Cedar Island, Flood Pt.	0	6	3		2	43
4	Frances Creek	178	112	131		401	179
5	Half Moon Island	55	101	3		1	1
6	Jacks Island, Sandy Pt.	9	0	0		0	2
7	Webb Island	138	0			0	5
8	Beach Island	766	636	46		273	213
8A	Tobacco Island	0					
	1-8 Totals	**1354**	**934**	**449**		**1664**	**997**
9	Chesconessex South	7	81	47		49	4
10	Back Creek	28	130	162		66	84
11	Parkers Marsh	767	1629	12554		4587	3343
12	Thickets Creek	0	20	40		28	12
13	Parkers Island	21	109	60		1278	407
14	Butcher Creek North	193	418	531		136	83
15	Hacks Neck	497	874	126		662	751
16	Hyslop Marsh	898	2988	1954		2424	640
17	Scarborough Neck	2705	4087	1789		2996	1493
	9-17 Totals	**5116**	**10336**	**17263**		**12226**	**6817**
18	Occohannock Neck N.	1013	2606	1187		1031	1537
19	Battle Point S.	103	520	65		164	19
20	Silver-Downings Beach	1609	4417	1413	1232	2478	547
21N	Church Neck North	1745	7979	2297			
	north spit		343				
21	Church Neck	2492	2678	1807		2566	3384
39	Hungars	125					
22	Smith Beach	632	390	365		113	307
23	Wilkins Beach	510	59	214		667	1678
24	Tankards Beach	2270	5107	1248	975	1146	1791
25	Savage Neck	6948	9657	8619		4375	7368
	18-25 Totals	**17447**	**33756**	**17215**	**2207**	**12540**	**16631**
26	Kings Creek	173	535	751		1247	176
27	Cape Charles South	696	194	1491		2458	3452
28	Elliots Creek North	397	145	85		631	739
29	Elliots Creek South	86	11	203		425	204
30	Picketts Harbor	142	149	792		2166	2412
31	Butlers Bluff	14	10	22		30	245
32	Kiptopeke State Park	17	0	175		37	301
33	Latimer	25	0	9		10	51
34	Wise Point	46	12	43		35	80
35	Tangier Island	331		48			38
	26-35 Totals	**1927**	**1056**	**3619**		**7039**	**7698**
	Grand Total	**25,844**	**46,082**	**38,546**		**33,469**	**32,143**

Northern Marsh Beaches (9-17)

This area includes nine sites, several small and others large, and all beaches backed by marshes. The overall count for all sites was 5,116, the lowest total of all previous surveys. All sites had lower counts than 2009, several less than half of the most recent counts. These sites include mostly natural beaches along the mainland with no shoreline armoring; only two sites had any development, both with a single house behind the beach. One of the most significant declines was at Parkers Marsh with a count of 767 compared to the previous low of 1,629 in 2009 and over 12,000 in 2005. The cause of the progressive decline at this site seems to be shoreline narrowing. Hyslop Marsh, a site with a beach physically similar to Parkers Marsh, also experienced a significant decline to 898 adults compared to near or over 2,000 in the three previous counts. Observations suggested that beach width was significantly narrower in 2016 than in 2009. Parkers Island had only 21 adults in 2016 compared to a peak of 1,278 in 2002. This low marsh island is apparently being lost to erosion/sea level rise because there was very little exposed sandy beach in 2016. Hacks Neck had the second lowest count (497) primarily due to a significant decline in numbers in the northeastern part of the site where the beach was noticeably narrower. In general, the decline in this area is probably a result of natural shoreline recession at many sites.

Middle Sites (18-25)

This section includes mostly large sites with large populations and significant sections of shoreline armoring at several sites, some of the armoring added since 2009. The total count of 17,447 for this section was similar to the 1999, 2002, and 2005 counts, but only about half of the 2009 count (33,756). Here also the cause of the decline seems to be shoreline recession. Occohannock Neck numbers in 2016 (1,013) declined from the peak of 2,606 in 2009, but were similar to the previous low of 1,031 in 2002. This site has two new breakwaters in the northern third and two other new ones farther south. South of these latter two is a long section of unsuitable habitat with a seawall backed by houses and an access road. The road and houses have been added within the past decade. Battle Point South is armored with groins and seawall along most of its length. The count was 103 in 2016 compared to the significantly higher count of 520 in 2009; counts were near or less than 100 in other previous years. All adults were confined to two small beach areas between structures near the north end. All of the south end that had groins and a seawall with no exposed beach at mid and high tide supported some adults in earlier years, but none in 2016.

The number of *H. d. dorsalis* at Silver-Downings Beach (1,609) was significantly lower than in 2009 but higher than three other years. The north section had several new breakwaters with arc beaches between them, and supported moderate numbers. The short, heavily used Camp Silver Beach had small numbers while the long natural beach to the south supported most of the population. South of here to the far end of the site is an unsuitable habitat section with houses, shoreline structures, and little or no exposed beach. The next sites to the south (Church Neck and Church Neck North) have long sections of natural, unarmored shoreline with very large *H. d. dorsalis* populations in previous surveys. Church Neck North had one of the largest declines compared to 2009 (over 8,000 to 1,745) while the Church Neck number (2,492) was similar to several recent counts. The cause of the decline at Church Neck North is uncertain. A portion of this site has houses several hundred meters behind the beach which probably accounts for the observed evidence of pedestrian beach use although it was minimal and without apparent impact on the habitat. In the past 10+ years there has been a progressive beach accretion at the south end that supports tiger beetles.

Savage Neck had the longest shoreline and highest count of any Eastern Shore site with both natural and armored shoreline. The total count of 6,948 included 1,448 in the north section (328 of these in a short section with three offshore breakwaters), 3,170 in the Virginia Department of Conservation and Recreation's Savage Neck Dunes Natural Area Preserve portion, and 2,330 in the south portion that included both armored and natural beach sections. Large numbers of beetles were also found in the three adjacent sites to the north: Tankards (2,270), Wilkins (510), and Smith Beach (632). Tankards continues to have a very wide beach backed by high cliffs with no shoreline structures and ideal habitat. Smith and Wilkins are fully armored with groins, bulkheads, and seawalls and have relatively narrow beaches backed by houses for their whole length. Despite this seemingly marginal or unsuitable habitat, the consistent presence of large numbers of adult beetles in all years suggests these sites may support successful larval development. It is also possible that many of the adults moved from the very large, dense populations to the south.

Southern Sites (26-35)

This section was distinct from other sections in having a higher count in 2016 (1,927) than 2009 (1,056). However, this increase was primarily a result

of large increases at Cape Charles South and Tangier Island. The two northern sites in this section are part of the Bay Creek development and receive a moderate amount of pedestrian beach use. The Kings Creek site along the mouth of Kings Creek had declining numbers for the past two surveys, (535 in 2009 and 173 in 2016 compared to 751 in 2005 and 1,247 in 2002). In 2016, most of the adults were north of the breakwaters section in the area of the creek mouth. The number at Cape Charles South increased from 194 in 2009 to 696 in 2016. This site had counts of 3,452 in 1999 and 1,491 in 2005 prior to the construction of eight breakwaters in the southern half of the site. The low count in 2009 and several subsequent years was believed to be a result of the use of heavy equipment for beach cleaning and maintenance. The significant increase in 2016 was considered to be a result of the cessation of this activity in 2015. Interesting, most of the adults in 2016 were in the breakwater section and very few to the north, unlike some of the earlier counts when many adults were in the northern half of the shoreline. This distribution and larval surveys indicate the population is utilizing the breakwater section of the site. The south end of this site at the mouth of Plantation Creek continues to change, but as in previous years includes sandy beach which supports moderate numbers of adults and apparently larvae.

Elliotts Creek North had a significantly higher count (397) in 2016 than in 2009 and 2005, but less than 2002 (631) and 1999 (739) when the shoreline was less armored. Of note is that 229 of the 2016 adults were in the unmodified sandy beach around the creek mouth. South of here was a long section of armoring, including breakwaters, groins, and rip rap. This armoring was present in 2005, but has increased since then. Other adults were near the south end in an arc beach between two spurs and within a very small beach on the north side of the mouth of Elliotts Creek. Elliotts Creek South yielded a count of 86 in 2016 as compared to only 11 in 2009, and several hundred in previous counts. The south end of the site includes rip rap and a narrow beach with no beetles. The middle to north end has an unarmored more natural beach where the adults occurred, especially the north end around the creek mouth.

Picketts Harbor includes a long section of shoreline that through 2002 supported a large population of over 1,000-2,000 adults in the earliest surveys. Numbers declined to 792 in 2005, 149 in 2009, and 142 in 2016. The long southern portion of the site with no armoring or apparent disruptions has supported most of the population, although many fewer than in earlier years. The northern half of the site has more disturbance, some structures, and evidence of continuing erosion and had fewer adults (22) in 2016 than earlier years. Butlers Bluff, a site backed by high bluffs along most of its length had 14 adults in 2016 and similar low numbers since 1999 when the site had 245. The cause of the significant decline is likely shoreline erosion and associated impacts of the breakwaters and seawall/ bulkhead along all but the northern end of the site. The far north end is unarmored but still has few adults. Breakwaters in the southern part of the site have wider beach but few adults. The middle sea-wall section is very eroded with much of the seawall overwashed and severely damaged. Kiptopeke State Park had only 17 adults in 2016 compared to 0 in 2009 and a peak of 301 in 1999. The establishment of the State Park resulted in heavy pedestrian use that is the probable cause of the decline in beetle numbers.

Latimer is a relatively long site backed by bluffs along its length. It had 25 adults in 2016 compared to none in 2009 and a peak of 51 in 1999. The site includes a narrow beach and thus mostly no or marginal habitat. Tangier Island was surveyed in 2015 and produced a total count of 331 adults. The count in 2005 was 48 adults, but this included only the main island and not Port Isobel where 280 adults were counted in 2015. The other 51 adults were found at the southeastern tip of the main island which had all 38 beetles counted in 1999.

Final Comments

The results of this survey indicate a significant decline in total numbers from the peak count in 2009 and from all previous surveys. The 2009 survey documented an apparent trend of increase from 1999 to 2009 (Knisley et al., 2016), but the 2016 results suggest a possible decline that could have been occurring after 2009. The causes of the decline in 2016 cannot be determined but the observed shoreline recession and increase in armoring at some sites are the likely causes. The increase and proportional amount of shoreline armoring and developments in the past 15-20 years has been much less than along the western shoreline of the Chesapeake Bay in Virginia where *H. d. dorsalis* numbers have declined much more significantly (Knisley et al., 2016). The eastern shore is much less developed, has more isolated sites, and is less likely than the western shoreline to be impacted from human activities and development. However, both shorelines are experiencing progressive shoreline recession and continued decline of populations of *H. d. dorsalis* throughout Virginia is a serious concern for the future of this species. It is also not certain if 2016 indicates a trend of decline or simply a low abundance year that will be followed by a rebound. Year-to-year variations

in abundance are typical for this and other species of tiger beetles, and several more years of lower numbers are needed to confirm a trend of decline.

ACKNOWLEDGMENTS

Thanks to the U. S. Fish and Wildlife Service, Virginia Field Office, especially Sarah Nystrom and Troy Anderson, for obtaining funding for this important survey. I greatly appreciate the assistance of Mike Fenster for providing excellent boat support for accessing most of the survey sites and to Steve Roble for preparing Figure 1.

LITERATURE CITED

Buhlmann, K. A., & C. A. Pague. 1992. Natural heritage inventory of *Cicindela dorsalis dorsalis* (Northeastern Beach Tiger Beetle) on the Chesapeake Bay beaches of Virginia. Natural Heritage Technical Report 92-16. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond, VA. 41 pp.

Clark, K. H. 1997. Monitoring of Northeastern Beach Tiger Beetles (*Cicindela dorsalis dorsalis*) on sites protected by the Virginia Department of Conservation and Recreation, 1996 and 1997. Virginia Natural Heritage Technical Report 97-19. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond, VA. 9 pp.

Hill, J. M., & C. B. Knisley. 1994. A metapopulation study of the threatened Northeastern Beach Tiger Beetle (*Cicindela dorsalis dorsalis*) in Northumberland County, Virginia, 1994. Report to Virginia Department of Conservation and Recreation. 10 pp. plus appendix.

Knisley, C. B. 1997. Distribution and abundance of the Northeastern Beach Tiger Beetle, *Cicindela dorsalis*, in relation to shoreline modifications, in Virginia. Report to the Virginia Department of Agriculture and Consumer Affairs, Office of Plant Protection, Endangered Species Coordinator. Richmond, VA. 19 pp. plus figures and tables.

Knisley, C. B. 2009. A survey of the Northeastern Beach Tiger Beetle (*Cicindela dorsalis dorsalis*) at Eastern Shore of Virginia sites, 2009. Final report to U. S. Fish and Wildlife Service, Virginia Field Office. Gloucester, VA. 32 pp.

Knisley, C. B. 2016. A survey of the Northeastern Beach Tiger Beetle (*Cicindela dorsalis dorsalis*) at Eastern Shore of Virginia sites, 2016. Final report to U. S. Fish and Wildlife Service, Virginia Field Office. Gloucester, VA. 18 pp.

Knisley, C. B., M. Drummond, & J. McCann. 2016. Population trends of the Northeastern Beach Tiger Beetle (*Cicindela dorsalis dorsalis* Say) in Virginia and Maryland, 1980s through 2014. Coleopterists Bulletin 70: 255-271.

Knisley, C. B., J. M. Hill, & C. Schulz. 1998. Distribution and abundance of the Northeastern Beach Tiger Beetle (*Cicindela dorsalis dorsalis*) along the western shoreline of the Chesapeake Bay of Virginia, 1998. Banisteria 6: 23-29.

Roble, S. M. 1996. Distribution, abundance and conservation status of the Northeastern Beach Tiger Beetle in Virginia: 1995 summary report. Natural Heritage Technical Report 96-4. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond, VA. 20 pp.

U. S. Fish and Wildlife Service. 1994. Northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*) recovery plan. U. S. Fish and Wildlife Service. Hadley, MA. 45 pp.

Banisteria, Number 48, pages 9-13

Use of Rock-crevices in Winter by Big Brown Bats and Eastern Small-footed Bats in the Appalachian Ridge and Valley of Virginia

Paul R. Moosman, Jr.[1*], P. Reid Anderson[2], and Martin G. Frasier[1]

[1]Virginia Military Institute
Department of Biology
303 Maury-Brooke Hall
Lexington, Virginia 24450

[2]Virginia Commonwealth University
Department of Biology
1000 W. Cary Street
Richmond, Virginia 23220

ABSTRACT

Published accounts of North American bats overwintering in places other than caves and mines are rare. We used repeated visual searches for roosting bats to document use of sandstone rock-ledges in west-central Virginia by *Eptesicus fuscus* (Big Brown Bat) and *Myotis leibii* (Eastern Small-footed Bat) during two consecutive winters. Crevices used by both species tended to be smaller than nearby randomly selected crevices. It is unclear if bats hibernated exclusively in the rock-crevices or moved back and forth between them and other refugia such as caves or mines. Rock-crevices likely are more isolated and colder and drier than most caves and mines and conceivably could offer greater protection from White-nose Syndrome.

Key words: *Eptesicus fuscus*, hibernation, *Myotis leibii*, roosts, White-nose Syndrome.

INTRODUCTION

Overwintering habits of bats are an important part of their life history in temperate regions, a fact underscored by recent mortality from White-nose Syndrome (WNS), a disease caused by the fungus *Pseudogymnoascus destructans* (Gargas et al., 2009; Lorch et al., 2011). This disease has led to unprecedented reductions in populations of several bat species that hibernate in caves and mines in eastern North America (Turner et al., 2011). Species such as the Little Brown Bat (*Myotis lucifugus*), Northern Long-eared Bat (*Myotis septentrionalis*), and Tricolored Bat (*Perimyotis subflavus*), have experienced especially severe declines, whereas others such as the Big Brown Bat (*Eptesicus fuscus*) and Eastern Small-footed Bat (*Myotis leibii*) apparently have suffered substantial but less severe losses (Turner et al., 2011; Francl et al., 2012; Moosman et al., 2013). Lower mortality rates from WNS in *E. fuscus* and *M. leibii* may be because their hibernating habits make them less susceptible, from decreased fungal loads and growth rates (Langwig et al., 2012, 2016). Both *E. fuscus* and *M. leibii* tend to roost alone or cluster in relatively small groups, are found in colder and drier parts of hibernacula, and they often arrive at hibernacula later in the fall and leave earlier in the spring than other species of bats that have been affected by WNS (Kurta & Baker, 1990; Best & Jennings, 1997; Agosta, 2002).

Most knowledge of the overwintering habits of *E. fuscus* and *M. leibii*, and indeed other species of "cave-hibernating" bats in North America, is from caves and mines (and buildings in the case of *E. fuscus*), and mostly from eastern North America where karst habitat is abundant. However, a few studies hint that the overwintering habits of *E. fuscus* and *M. leibii* could be more diverse than has been commonly described in the literature. *Eptesicus fuscus* in the western portion of its range roosts in rock-crevices during cold weather in

* Corresponding author: moosmanpr@vmi.edu

autumn and as hibernacula (Lausen & Barclay, 2006; Neubaum et al., 2006), and *M. leibii* in Virginia have been found in rock-crevices on talus slopes during periods of relatively extreme cold in spring and autumn (Moosman et al., 2015). The extent to which "cave-hibernating" bats overwinter on the landscape is still poorly understood, especially in eastern North America.

STUDY AREA AND METHODS

We observed *E. fuscus* and *M. leibii* roosting in crevices of southwest-facing sandstone ledges (Wilkes et al., 2007) during the winters of 2015-2016 and 2016-2017, in Goshen Pass (North 37°56', West 79°27'), a ravine formed by the Maury River as it passes southeast through the Appalachian Ridge and Valley Region, in Rockbridge County, Virginia. The rock-ledges are part of a popular sport-climbing area on the north side of the ravine and were accessible by the Goshen Pass Hiking Trail in the Goshen Wildlife Management Area and the Goshen Pass Natural Area Preserve. Elevations range from around 400 m at the river to 957 m at the summit of Jump Rock Mountain. We first observed a solitary *E. fuscus* on 5 December 2015, and revisited the crevice on 12 December to find it occupied by what may have been the same bat (Fig. 1). We returned and searched more crevices on 18 December 2015 and 3 January 2016 and found solitary *E. fuscus* in other crevices. After these four initial visits, we conducted 10 systematic surveys along the rock-ledges to document the extent to which bats used the site.

We surveyed for bats approximately every 1-3 weeks (average = 14 days between visits), including seven times between 9 February and 16 April 2016, and three times the following winter between 15 January and 18 February 2017. Surveys were conducted by 1-2 people who searched crevices along the rock-ledges for 1-2 person-hours per visit, on the same 3 km segment of trail where we initially observed bats. During surveys we visually inspected every crevice, regardless of size, between the ground and head height (about 2 m above ground) with 400-lumen flashlights for the presence of bats. Surveys covered only a small portion of potential roosting sites because the rock-ledges ranged from 1-m tall to higher than the forest canopy. The opposite side of Goshen Pass also had exposed rocky sites (predominantly northeast-facing) that we did not survey because access was more difficult and we were constrained by time. Rock-faces on both sides of Goshen Pass were predominantly under the tree canopy, but exposed to sunlight because trees lacked foliage. Capture and handling of bats was conducted under a scientific collecting permit (#056504) from the Virginia Department of Game and Inland Fisheries and approval from the Animal Subjects Committee at the Virginia Military Institute.

We marked roosts using aluminum numbered tags held in the crevice with heavy gauge metal wire and recorded latitude and longitude coordinates with a Magellan Triton 500 GPS unit (Santa Clara, California; ±5 m). We quantified microhabitat using methods similar to Neubaum et al. (2006), by determining length and width of the opening, and height from the ground to the bottom of the crevice (to the nearest 0.1 m) using a measuring tape. We defined width as the space between the two planar surfaces creating the crevice (i.e., top and bottom surfaces for horizontal crevices, or left and right surfaces for vertical crevices). The aspect of crevices was estimated using a magnetic compass. We obtained the same measurements (with the exception of aspect) from 12 randomly selected crevices. These were chosen by selecting a random direction along the ravine (west or east) and distance from the roost (≤ 15-m) using SPSS version 23 software (International Business Machines, Corp., Armonk, New York). We selected the rock-crevice nearest to each random point that was large enough for *E. fuscus* (the larger of the study species) to enter (opening at least 3.2 cm long x 1.0 cm wide; Greenhall, 1982). Dimensions of roosts and random crevices were compared using One-way ANOVA, with significant differences accepted at α of 0.05. All results are reported as mean ± SD.

RESULTS

During the 10 systematic surveys, we observed *E. fuscus* on five visits and *M. leibii* on three visits (2.19 ± 0.97 bats per person-hour of searching). Most bats were observed roosting solitarily, but we found pairs of bats on two occasions, including *M. leibii* on 1 March 2016 and *E. fuscus* on 11 March 2016. On 11 March, we also heard social calls of bats, which are typically produced by groups of roosting bats, emanating from too high above the ground for us to locate the source. We captured by hand and banded only three bats at the end of each winter to avoid influencing their behavior, thus it is unclear how many separate bats our observations represent. Captured bats included three male *E. fuscus* (1 scrotal and 1 non-scrotal on 16 April 2016; 1 scrotal on 4 February 2017), and one non-scrotal male *M. leibii* on 18 February 2017. Only the non-scrotal *E. fuscus* had blotches of white skin and physical scarring on its wings resembling that caused by WNS.

Average daily minimum and maximum temperatures on days we observed bats, obtained at a weather station 33 km away in the town of Hot Springs (Bath County), were 1.3 ± 7.4 °C and 9.9 ± 6.2 °C, respectively. The coldest day on which we observed bats was 4 February

Fig. 1. Examples of roosts used by *Eptesicus fuscus* (A) and *Myotis leibii* (B) during winter in Goshen Pass, Rockbridge County, Virginia. Rock-ledge A was 2-3 m high and was used on 5 and 12 December 2015; rock-ledge B was about 1 m high and was used on 18 February 2017.

Table 1. Comparison of rock-crevices used by *Eptesicus fuscus* and *Myotis leibii* during the winters of 2015-2017 and nearby random crevices, in Goshen Pass, Rockbridge County, Virginia. Data are reported as mean ± SD.

Type of Crevice	Observations of Bats (n) *	Crevices (n)	Length (cm)	Width (cm)	Height from Ground (cm)	Aspect (°)
Eptesicus fuscus	14	13	41.5±29.5	2.4±1.4	133±36	228±47
Myotis leibii	5	4	35.8±25.8	2.6±1.7	109±52	207±18
Random	-	12	40.5±23.5	6.1±7.2	101±71	203±49

* Total number of bats observed is not known because most bats were not banded.

2017 (min: -12.2 °C, max: 0 °C). Including all visits, we observed bats on 11 of 14 dates (79%). Roosts of both species of bats were in crevices of comparable dimensions; these tended to be barely wide enough for the bats to fit inside, and they were often narrower than randomly selected crevices (Fig. 1, Table 1). Roosts were statistically similar to random crevices with respect to width (P=0.072), aspect (P=0.501), length (P=0.625), and height from ground (P=0.729). Data from both winters combined indicate *E. fuscus* was present at Goshen Pass from (at least) early December until mid-April, and *M. leibii* from mid-February to mid-April, including days when the air temperature was below freezing.

DISCUSSION

These data are the first direct observations of *M. leibii* overwintering in rock-crevices and the only record to date of *E. fuscus* doing so in eastern North America. It is unclear whether the bats we observed hibernated exclusively in the rock-crevices in Goshen Pass, or if they made periodic movements between the crevices and other sites. Regardless, the frequency with which we encountered bats suggests the rock-ledges were an important overwintering resource. Langwig et al. (2016) showed that bats that hibernated solitarily or in small groups, and in colder microclimates had lower load and prevalence of the fungus that causes WNS. It is conceivable that hibernating in rock-crevices provides more isolation from other bats and colder microclimates than doing so in caves and mines, perhaps contributing to lower susceptibility to WNS.

More broadly, our observations cause us to ask: have bats changed their hibernating habits because of WNS, or has the behavior simply gone unnoticed because so much research has focused on caves and mines? We cannot answer this question, but note that: (1) *E. fuscus* and *M. leibii* routinely hibernate at particularly low temperatures compared to other species of bats in North America (Kurta & Baker, 1990; Best & Jennings, 1997); (2) rock-crevices are used as overwintering sites by *E. fuscus* (and perhaps the Western Small-footed Bat, *Myotis ciliolabrum*) in places with colder winters than much of eastern North America (Klug-Baerwald et al., 2017) and (3) other species of bats in eastern North America overwinter above ground, including Silver-haired Bats (*Lasionycteris noctivagans*) in tree cavities in Arkansas (Perry et al., 2010) and Eastern Red Bats (*Lasiurus borealis*) in conifers and leaf litter in Missouri (Mormann & Robbins, 2007). Thus, there seems little reason to think *E. fuscus* and *M. leibii* were not doing so prior to WNS. Additional study of the overwintering habits of these and other "cave-hibernating" species of bats is clearly warranted.

LITERATURE CITED

Agosta, S. J. 2002. Habitat use, diet and roost selection by the Big Brown Bat (*Eptesicus fuscus*) in North America: a case for conserving an abundant species. Mammalian Review 32: 179-198.

Best, T. L., & J. B. Jennings. 1997. *Myotis leibii*. Mammalian Species 547: 1-6.

Francl, K. E., W. M. Ford, D. W. Sparks, & V. Brack, Jr. 2012. Capture and reproductive trends in summer bat communities in West Virginia: Assessing the impact of white-nose syndrome. Journal of Fish and Wildlife Management 3: 33-42.

Gargas, A., M. T. Trest, M. Christensen, T. J. Volk, & D. S. Blehert. 2009. *Geomyces destructans* sp. nov. associated with bat white-nose syndrome. Mycotaxon 108: 147-154.

Greenhall, A. M. 1982. House bat management. United States Fish and Wildlife Service, Resource Publication 143: 1-33.

Klüg-Baerwald, B. J., C. L. Lausen, C. K. R. Willis, & R. M. Brigham. 2017. Home is where you hang your hat: winter roost selection by prairie-living big brown bats. Journal of Mammalogy 98: 752-760.

Kurta, A., & R. H. Baker. 1990. *Eptesicus fuscus*. Mammalian Species 356: 1-10.

Lausen, C. L., & R. M. R. Barclay. 2006. Winter bat activity in the Canadian prairies. Canadian Journal of Zoology 84: 1079-1086.

Langwig, K. E., W. F. Frick, J. T. Bried, A. C. Hicks, T. H. Kunz, & A. M. Kilpatrick. 2012. Sociality, density-dependence and microclimates determine the persistence of populations suffering from a novel fungal disease, white-nose syndrome. Ecology Letters 15: 1050-1057.

Langwig, K. E., W. F. Frick, J. R. Hoyt, K. L. Parise, K. P. Drees, T. H. Kunz, J. T. Foster, & A. M. Kilpatrick. 2016. Drivers of variation in species impacts for a multi-host fungal disease of bats. Philosophical Transactions of the Royal Society, B. 371: 20150456.

Lorch, J. M., C. U. Meteyer, M. J. Behr, J. G. Boyles, P. M. Cryan, A. C. Hicks, A. E. Ballmann, J. T. H. Coleman, D. N. Redell, D. M. Reeder, & D. S. Blehert. 2011. Experimental infection of bats with *Geomyces destructans* causes white-nose syndrome. Nature 480: 376-379.

Moosman, P. R., Jr., J. P. Veilleux, G. W. Pelton, & H. H. Thomas. 2013. Changes in capture rates in a community of bats in New Hampshire during the progression of white-nose syndrome. Northeastern Naturalist 20: 552-558.

Moosman P. R., Jr., D. P. Warner, R. H. Hendren, & M. J. Hosler. 2015. Potential for monitoring eastern small-footed bats on talus slopes. Northeastern Naturalist 22: 1-13.

Mormann, B. M., & L. W. Robbins. 2007. Winter roosting ecology of eastern red bats (*Lasiurus borealis*) in southwest Missouri. Journal of Wildlife Management 71: 213-217.

Neubaum D. J., T. J. O'Shea, & K. R. Wilson. 2006. Autumn migration and selection of rock crevices as hibernacula by big brown bats in Colorado. Journal of Mammalogy 87: 470-479.

Perry, R. W., D. A. Saugey, & B. G. Crump. 2010. Winter roosting ecology of silver-haired bats in an Arkansas forest. Southeastern Naturalist 9: 563-572.

Turner, G. C., D. A. M. Reeder, & J. T. H. Coleman. 2011. A five-year assessment of mortality and geographic spread of white-nose syndrome in North American bats and a look into the future. Bat Research News 52: 13-27.

Wilkes, G. P., E. W. Spencer, N. H. Evans, & E. V. M. Campbell. 2007. Geology of Rockbridge County, Virginia. Virginia Division of Mineral Resources, Publication 170. 33 pp.

Shorter Contributions

Banisteria, Number 48, pages 14-16

First Record of the Rove Beetle *Trigonodemus striatus* LeConte (Coleoptera: Staphylinidae) from Virginia and Additional New Park Records (Coleoptera: Anthicidae, Buprestidae, Carabidae, Cerambycidae, Chrysomelidae) for the George Washington Memorial Parkway

Brent W. Steury
U.S. National Park Service
700 George Washington Memorial Parkway
Turkey Run Park Headquarters
McLean, Virginia 22101

Continued sorting of Malaise trap samples obtained from national park sites within the George Washington Memorial Parkway (Dyke Marsh Wildlife Preserve, Great Falls Park, and Turkey Run Park) and more recent hand picking, has produced new beetle records for the park and for Virginia. The park boundaries are discussed and delineated on a map provided in Steury (2011). Specimens are deposited at the Turkey Run Park Headquarters of the George Washington Memorial Parkway (GWMP) in McLean, Virginia. These new records are summarized below.

Staphylinidae

Trigonodemus striatus LeConte – Fairfax Co.: western end of Turkey Run Park, 22 October-17 November 2006; Turkey Run Park gulch, 5 September-21 October 2009, both collections B. Steury and D. Smith (GWMP, 2). **NEW STATE RECORD.**

These Virginia records represent a southern range extension from Pennsylvania for this rove beetle. Webster et al. (2012) documented it from New Brunswick, Nova Scotia, Ontario, and Quebec, Canada. Newton et al. (2001) recorded its range as "northeastern United States and southeastern Canada," Downie & Arnett (1996) included New York, Pennsylvania, and Indiana within its range, and Smetana (1996) added New Hampshire. Evans (2014) provides a macro-image of its dorsal habitus. The genus contains six species known from Taiwan, Japan, North America (2), and China (2), indicating a relict Tertiary distribution (Smetana, 1996). The habitat of *T. striatus* has been described as mature mixed forest, old-growth northern hardwood forest, and eastern white cedar swamp (Webster et al., 2012). It may be an indicator of old growth habitats. It is a fungicolous species occurring in mushrooms including the genera *Russula* and *Pholiota* (Smetana, 1996; Webster et al., 2012). Captures reported by Smetana (1996) and Webster et al. (2012) were from September and October. These Malaise trap captures, set in mature basic mesic hardwood forest, indicate that *T. striatus* is active in late October and possibly early November in northern Virginia.

Anthicidae

The following records increase the number of antlike flower beetles documented from the park to 12 species (Steury et al., 2013).

Macratria confusa LeConte – Fairfax Co.: Turkey Run Park ravine, 22 June-6 July 2006, B. Steury and D. Smith (GWMP, 1).

Notoxus desertus Casey – Fairfax Co.: Great Falls Park quarry, 23 May-5 June 2008, B. Steury and D. Smith (GWMP, 1).

Buprestidae

This record increases the tally of jewel beetles known from the park to 27 species (Steury et al., 2012; Steury & Messer, 2015).

Actenodes acornis (Say) – Fairfax Co.: Great Falls Park swamp, 15-29 June 2006, B. Steury and D. Smith (GWMP, 1). Many of the larval host plants documented for this beetle are found in Great Falls Park including *Acer rubrum* L., *Carya glabra* (Mill.) Sweet, *Cercis canadensis* L., *Fagus grandifolia* Ehrh., and *Quercus velutina* Lam. (Steury, et al., 2008; Paiero et al., 2012).

Carabidae

These records increase the number of ground beetles documented from the Potomac River Gorge (POGO), an area that has been surveyed for beetles for over 100 years, to 260 species and raise the park total to 197 (Brown, 2008; Steury et al., 2014; Steury & Messer, 2014, 2015).

Agonum albicrus Dejean – Fairfax Co.: Turkey Run Park river trail, 16-30 July 2009, B. Steury and D. Smith (GWMP, 1). New POGO Record.

Dromius piceus Dejean – Fairfax Co.: Great Falls Park quarry, 5-25 August 2008, B. Steury and D. Smith

(GWMP, 1).

Lebia pulchella Dejean – Fairfax Co.: Great Falls Park quarry, 19-30 June 2009, B. Steury and D. Smith (GWMP, 1). New POGO Record.

Perigona pallipennis (LeConte) – Fairfax Co.: Great Falls Park quarry, 21 May-18 June 2009, B. Steury and D. Smith (GWMP, 1). New POGO Record.

Selenophorus hylacis (Say) – Fairfax Co.: Great Falls Park quarry, 30 June-13 Aug 2006, B. Steury and D. Smith (GWMP, 1). New POGO Record.

Cerambycidae

This record increases the number of longhorned beetles known from the park to 81 species (Steury & MacRae, 2014).

Elytrimitatrix undata (Fabricius) – Fairfax Co.: Turkey Run Park river trail, 18 August-4 September 2009, B. Steury and D. Smith (GWMP, 1).

Chrysomelidae

The following records increase the number of leaf beetles known from the park to 107 species (Cavey et al., 2013; Steury et al., 2014) and those known from the Potomac River Gorge to 188 (Brown, 2008). Each species has been recorded in all of the Mid-Atlantic States (Staines & Staines, 2009). Documented host plants follow Clark et al. (2004).

Calligrapha bidenticola Brown – City of Alexandria: Daingerfield Island, collected on *Chenopodium album* L. adjacent to a patch of *Bidens* sp., 25 July 2016, B. Steury (GWMP, 1). Documented host plants are herbs in the family Asteraceae including *Ambrosia artemisiifolia* L., *Bidens frondosa* L., and *Bidens cernua* L.

Cryptocephalus badius Suffrian – Fairfax Co.: Turkey Run Park ravine, 22 June-6 July 2006, B. Steury and D. Smith (GWMP, 2). New POGO Record. Known host plants that occur near the collection site are the trees *Cercis canadensis* L., *Juglans nigra* L., and *Tilia* sp.

Systena marginalis (Illiger) – Fairfax Co.: Dyke Marsh Wildlife Preserve, 30 July 1998 and 2 July 1999, B. Steury and E. Barrows (GWMP, 2). Documented host plants found near the collection site include the herbs *Polymnia* sp. and *Polygonum* sp., the trees *Cercis canadensis* L., *Quercus rubra* L., and *Liquidambar styraciflua* L., and the woody vine *Parthenocissus*.

ACKNOWLEDGEMENTS

Much appreciation is extended to Don Chandler, University of New Hampshire, for confirming the identifications of the two anthicid species.

LITERATURE CITED

Brown, J. W. 2008. The invertebrate fauna of Plummers Island, Maryland. Contribution XXX to the Natural History of Plummers Island, Maryland. Bulletin of the Biological Society of Washington 15: 1-226.

Cavey, J. F., B. W. Steury, & E. T. Oberg. 2013. Leaf beetles (Coleoptera: Bruchidae, Chrysomelidae, Orsodacnidae) from the George Washington Memorial Parkway, Fairfax County, Virginia. Banisteria 41: 71-79.

Clark, S. M., D. G. LeDoux, T. N. Seeno, E. G. Riley, A. J. Gilbert, & J. M. Sullivan. 2004. Host plants of leaf beetle species occurring in the United States and Canada (Coleoptera: Megalopodidae, Orsodacnidae and Chrysomelidae exclusive of Bruchinae). Coleopterists Society Special Publication No. 2. Sacramento, CA. 476 pp.

Downie, N. M., & R. H. Arnett. 1996. The Beetles of Northeastern North America, Volume I. The Sandhill Crane Press, Gainesville, FL. 880 pp.

Evans, A. V. 2014. Beetles of Eastern North America. Princeton University Press, Princeton, NJ. 560 pp.

Newton, A. E., M. K. Thayer, J. S. Ashe, & D. S. Chandler. 2001. Staphylinidae Latreille, 1802. Pp. 272-418 *In* R. H. Arnett, Jr. & M. C. Thomas (eds.), American Beetles. Volume I. Archostemata, Myxophaga, Adephaga, Polyphaga: Staphyliniformia. CRC Press, Boca Raton, FL.

Paiero, S. M., M. D. Jackson, A. Jewiss-Gaines, T. Kimoto, B. D. Gill, & S. A. Marshall. 2012. Field Guide to the Jewel Beetles (Coleoptera: Buprestidae) of Northeastern North America. University of Guelph, Guelph, Ontario, Canada. 411 pp.

Smetana, A. 1996. A review of the genus *Trigonodemus* LeConte, 1863, with descriptions of two new species from Asia (Coleoptera: Staphylinidae: Omaliinae). Coleoptera, Schwanfelder Coleopterologische Mitteilungen 19: 1-18.

Staines, C. L., & S. L. Staines. 2009. The Chrysomelidae (Insecta: Coleoptera) of the Mid-Atlantic States.

Pp. 341-363 *In* S. M. Roble & J. C. Mitchell (eds.), A Lifetime of Contributions to Myriapodology and the Natural History of Virginia: A Festschrift in Honor of Richard L. Hoffman's 80th Birthday. Virginia Museum of Natural History Special Publication No. 16, Martinsville, VA.

Steury, B. W. 2011. Additions to the vascular flora of the George Washington Memorial Parkway, Virginia, Maryland, and the District of Columbia. Banisteria 37: 3-20.

Steury, B. W., D. S. Chandler, & W. E. Steiner. 2013. *Vacusus vicinus* (LaFerte Senectere) (Coleoptera: Anthicidae): Northern range extensions to Virginia, Maryland, Missouri, and Kansas. Banisteria 41: 97-98.

Steury, B. W., G. P. Fleming, & M. T. Strong. 2008. An emendation of the vascular flora of Great Falls Park, Fairfax County, Virginia. Castanea 73: 123-149.

Steury, B. W., & T. C. MacRae. 2014. The longhorned beetles (Insecta: Coleoptera: Cerambycidae) of the George Washington Memorial Parkway. Banisteria 44: 7-12.

Steury, B. W., T. C. MacRae, & E. T. Oberg. 2012. Annotated list of the metallic wood-boring beetles (Insecta: Coleoptera: Buprestidae) of the George Washington Memorial Parkway, Fairfax County, Virginia. Banisteria 39: 71-75.

Steury, B. W., & P. W. Messer. 2014. Twelve ground beetles new to Virginia or the District of Columbia and an annotated checklist of the Geadephaga (Coleoptera, Adephaga) from the George Washington Memorial Parkway. Banisteria 43: 40-55.

Steury, B. W. & P. W. Messer. 2015. Noteworthy beetle records from Virginia and Maryland (Coleoptera: Anthicidae, Buprestidae, Carabidae). Banisteria 45: 61-62.

Steury, B. W., P. W. Messer, & J. F. Cavey. 2014. Noteworthy beetle records from Virginia, Maryland, and the District of Columbia (Coleoptera: Carabidae and Chrysomelidae). Banisteria 44: 23-25.

Webster, R. P., J. D. Sweeney, & I. DeMerchant. 2012. New Staphylinidae (Coleoptera) records with new collection data from New Brunswick, Canada: Omaliinae, Micropeplinae, Phloeocharinae, Olisthaerinae, and Habrocerinae. Zookeys 186: 7-29.

Banisteria, Number 48, pages 16-17

A Tropical Butterfly Visits Virginia

Amos Showalter
320 Kindig Road
Waynesboro, Virginia 22980

A male Mimic butterfly, *Hypolimnas misippus* (Linnaeus), was collected on 17 September 2016 near Waynesboro, Augusta County, Virginia. Another male Mimic was photographed in the same area the next day (Fig. 1). A male was again observed there on 22 September 2016. Dave Wenger, a naturalist and owner/operator of Wenger Vineyard discovered these butterflies as they fed on some grapes that had been accidentally dropped.

Two of the larval food plants of the Mimic are Mallow (Malvaceae) and Morning Glory (*Ipomaea*) (Klots, 1951). The butterflies were found in or near an area where these food plants were growing. This and the fact that the butterflies were in perfect, freshly emerged condition suggests that they were progeny of a female Mimic that visited the area earlier in the summer. Repeated searches of this area did not produce any additional sightings.

The Mimic exhibits two phenomena that are seen frequently in butterflies. One is sexual dimorphism in which the two sexes have a different form or appearance. The other is Batesian mimicry which allows a mimic to gain protection from predators by appearing very similar to another species of butterfly, the model, that is distasteful or poisonous. The model, typically, has a bold, highly visible color pattern that a predator can easily remember and will avoid. Once a predator learns that a butterfly with a particular color pattern is distasteful, the predator will avoid all butterflies with that pattern including the mimic.

The model for the Mimic butterfly is *Danaus chrysippus* (Linnaeus), also known as the Plain Tiger or African Monarch, a species that occurs in southern Asia and Africa. This butterfly feeds on milkweed in the larval stage and is thought to be poisonous due to toxins produced by the milkweed. Only females of the Mimic actually mimic *D. chrysippus*, whereas male Mimics are mimics in name only (Smart, 1975).

The Mimic butterfly is also native to southern Asia and Africa (Smart, 1975). It was introduced into the Caribbean region, possibly by a slave ship (Klots, 1951), where it now occurs without a model. There is some evidence that the butterfly may also have arrived on its own via trans-Atlantic wind-borne dispersal (Smith

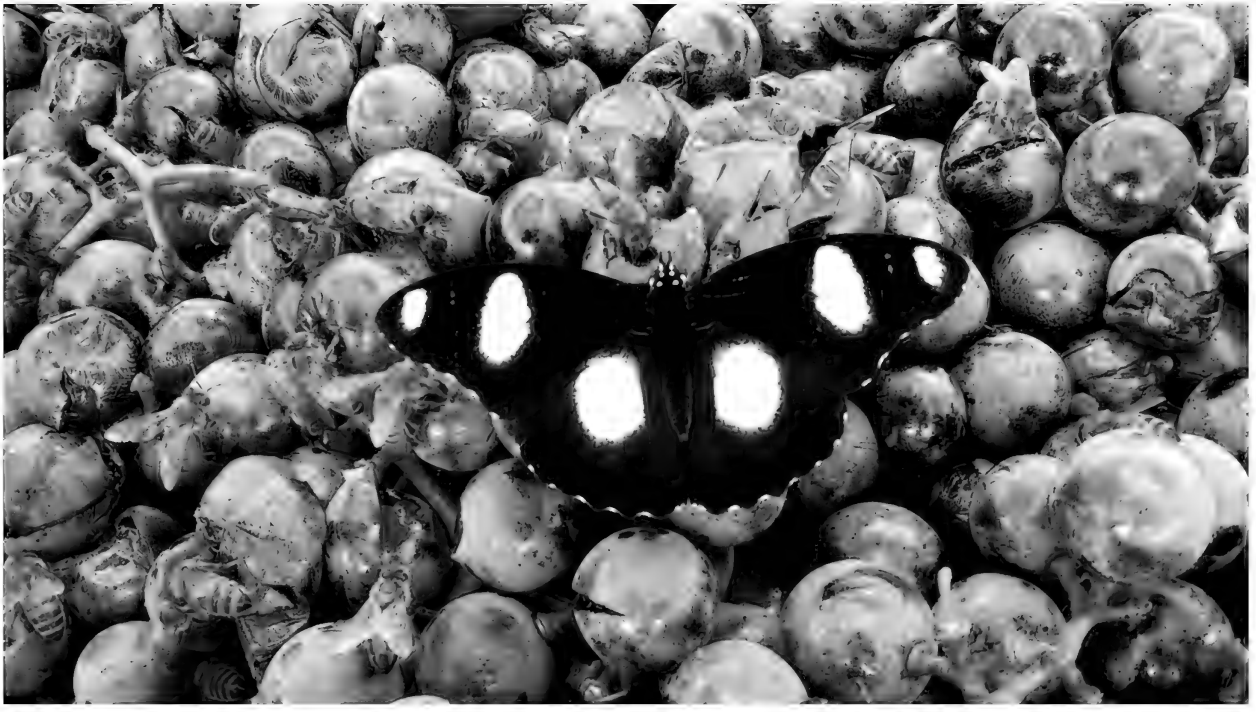


Fig. 1. A male Mimic butterfly, *Hypolimnas misippus* (Linnaeus), shares a feast of grape juice with honeybees on grapes that were accidentally dropped at Wenger Vineyard near Waynesboro, Virginia, 18 September 2016. (Photo: Kristi Stoltzfus)

et al., 1994). The Mimic is now resident in Venezuela and the Guianas (Smith et al., 1994). It has been found a number of times in the southeastern United States, most often in Florida (Klots, 1951), but also in North Carolina (LeGrand & Howard, 2017) and there is one recent record from Cape May, New Jersey (Reese, 2002). The September 2016 sightings are believed to be the first known occurrence of this species in Virginia.

ACKNOWLEDGMENTS

Thanks are extended to Dave Wenger for calling my attention to the occurrence of the Mimic butterfly on his farm, and to Kristi Stoltzfus for submitting the photograph of one of the butterflies. Charles V. Covell, Jr. and an anonymous reviewer provided helpful suggestions for this note.

LITERATURE CITED

Klots, A. B. 1951. A Field Guide to the Butterflies of North America, East of the Great Plains. Houghton Mifflin Company, Cambridge, MA. 349 pp.

LeGrand, H. E., Jr., & T. E. Howard. 2017. Butterflies of North Carolina, Twenty-fourth Approximation. North Carolina Natural Heritage Program & North Carolina State Parks. Published online: http://www.dpr.ncparks.gov/nbnc/index.html

Reese, M. 2002. Hot Seens, Summer/Fall 2002. American Butterflies 10(4): 38-39.

Smart, P. 1975. The International Butterfly Book. Salamander Books Limited, T. Y. Crowell Company, New York, NY. 275 pp.

Smith, D. S., L. D. Miller, & J. Y. Miller. 1994. The Butterflies of the West Indies and South Florida. Oxford University Press, New York, NY. 264 pp.

Banisteria, Number 48, pages 18-25

Early Wildlife Conservation and Education Efforts in Virginia: Correspondence of A. Willis Robertson

Heather N. Custer, Karen E. Powers, and Shane Brandes

Biology Department
Radford University
Radford, Virginia 24142

ABSTRACT

Although best known for his work as a member of the U.S. House of Representatives and his leadership in enacting the Federal Aid in Wildlife Restoration (Pittman-Robertson) Act, A. Willis Robertson was first and foremost an outdoorsman who led the Virginia Game Commission (now, Virginia Department of Game and Inland Fisheries) from 1926-1932. During his tenure as Chairman at the Game Commission, over 40,000 pieces of correspondence crossed his desk. These letters, both personal and political, covered topics of local game sustainability, wildlife management education, and his work with grassroots organizations. From our review of over 3,100 letters from 1928-1932, three themes are apparent: 1) Robertson encouraged local participation in conservation efforts (with focus on initiating chapters of the Izaak Walton League of America), 2) he directed efforts to restock depleted populations of native fauna, and 3) his political conversations spurred important conservation measures. In this paper, we present examples for each theme to demonstrate the conservation efforts of A. Willis Robertson during a time when such actions were essential first steps to recovering and sustaining the game populations now present in the Commonwealth.

Key words: Game Commission, Izaak Walton League of America, Virginia Department of Game and Inland Fisheries, wildlife management.

INTRODUCTION

Before A. (Absalom) Willis Robertson (Fig. 1) served as Chairman of the Game Commission (1926-1932) in Virginia, he had been an avid outdoorsman, a state senator, an army veteran, and a county attorney. One of six children and the son of a Baptist minister, Robertson was born in May 1887 in Martinsburg, West Virginia, where his interest in hunting and fishing as a youngster likely led to his lifelong support for natural resources and conservation. Robertson was employed as a lawyer until his election to the Virginia state senate in 1915. He volunteered in 1917 to serve in the U.S. Army as a first lieutenant after completing Officers Training Camp during World War I. In 1919, at the rank of major, Robertson was demobilized and returned to the state senate. After he resigned as state senator, Robertson became the Commonwealth attorney for Rockbridge County, Virginia in 1922. Throughout this time, he also was active in the American Legion, the Kiwanis Club, and the Masons (Heinemann, 2014).

Virginia's Commission of Game and Inland Fisheries, founded in 1916, comprised four individuals, including a fisheries commissioner, John S. Parsons and M. D. Hart who took the role as Chief Clerk of the Game Commission. The new agency lacked game and fish wardens at its inception. Wardens were later appointed through recommendations from town councils and held positions in nearly every county in the Commonwealth (Thompson & Francl-Powers, 2013). In 1926, Governor Harry F. Byrd appointed Robertson as Chairman of Virginia's Commission of Game and Inland Fisheries. During his six years in this position, Robertson received correspondence regarding conservation topics from local citizens, sportsmen, and government officials which today includes more than 40,000 archived documents currently held by the

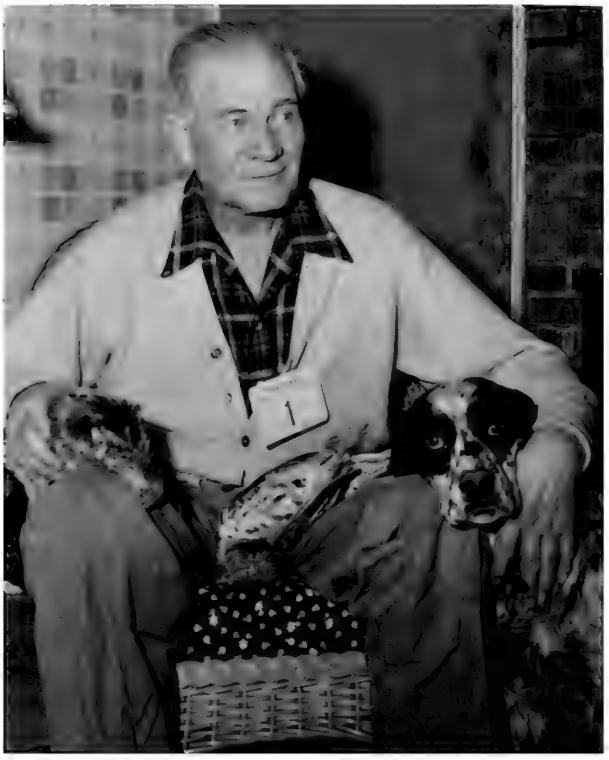


Fig. 1. A. Willis Robertson, Chairman of Virginia Game Commission, 1926-1932 (from U.S. Senate archives, 1956; courtesy of U.S. Fish and Wildlife Service National Conservation Training Center library).

Library of Virginia (LOV). For this paper, we examined approximately 3,100 documents in this collection (thought to be LOV duplicates), that are currently held in the Richmond headquarters office of the Virginia Department of Game and Inland Fisheries (VDGIF). We highlight three major components of letters he wrote: (1) his grassroots efforts to spur conservation activities, with special focus on the Izaak Walton League of America; (2) his direct efforts to increase depleted populations of native wildlife in Virginia; and (3) his political conversations to encourage wildlife conservation and sustainability. Through his personal and professional correspondence, we can gain insight into how Robertson encouraged others to initiate and sustain wildlife management and conservation practices.

GRASSROOTS EFFORTS: THE IZAAK WALTON LEAGUE OF AMERICA

As Chairman of the Game Commission, Robertson's influence was far-reaching but he understood the importance of building a base of supporters who could work at the local level. Robertson's correspondence revealed his support for and expansion of the Izaak Walton League of America (IWLA). The IWLA was founded nationally in 1922, focusing on outdoor conservation (IWLA, 2016). Robertson played a critical role in helping to establish IWLA chapters throughout Virginia, starting in 1928. He worked closely with Lynchburg, Virginia IWLA President, Mr. M.B. Mount, who shared Robertson's conservation interests. As recorded in the archived correspondence, Robertson spoke at meetings to spark enthusiasm throughout the public - specifically sportsmen - and sought to boost membership in local chapters.

The Izaak Walton League chapters in Virginia proved to be assets in these early conservation efforts. Their chapter meetings included professional speakers with national reputations to educate sportsmen and the public. Robertson frequently contacted employees from federal agencies (e.g., U.S. Forest Service, U.S. Bureau of Fisheries [now part of the U.S. Fish and Wildlife Service]) to speak to local chapters in Virginia. This ensured that accurate and current information was directly disseminated to the target audiences.

At a more memorable meeting, Robertson organized several professionals to speak. These professionals included:

> "…Mr. Titcomb, head of the Connecticut Department of Fish and Game and the greatest fish expert in the U.S. who will speak on trout and bass; Mr. Leach, head of propagation of the U.S. Bureau of Fisheries, who will speak on fish nurseries, Mr. Talbott Denmead of the U.S. Bureau of Biological Survey, who will speak on migratory birds; Major Kelley, head of the U.S. Forest Service who will speak on the national forests in Virginia with reference to conservation…" (Personal correspondence between Robertson and Mr. W.B. Moss of the Roanoke IWLA chapter, May 15, 1928).

Robertson's early correspondence with the IWLA chapters focused on sustainability of species that were hunted and fished. The path to sharing this message was establishing the many local chapters to act as conduits for information from and to the local level.

A major topic of discussion between Mount and Robertson was the proposed locations for each new chapter. Through correspondence, they carefully mapped out ideal IWLA chapter locations throughout Virginia and contacted potential leaders. On one occasion where Robertson suggested to Mount to help establish a chapter in Scott County, Virginia, Mount sent a statement to Senator Craft (R-Virginia, 1922-

unknown) that expresses just how much potential the IWLA could have throughout the state.

> "The Izaak Walton League is a national organization devoted to the preservation of outdoor America. At the present time there are thirteen chapters in Virginia; a number of others are in process of organization. The League is operated without profit and has no political affiliations. I know of no other state where there is a greater opportunity for the constructive conservation of wild life." (Personal correspondence between M. B. Mount and Senator Craft, February 11, 1929).

Furthermore, correspondence of Robertson and Mount with the extension bureau of the IWLA Chicago chapter indicated their desire to establish a state-level chapter in Virginia, the better to act as a conduit for messages sent by the national organization. Their efforts in establishing multiple IWLA chapters were successful because more chapters appeared throughout the state between 1928-1929 (e.g., Brookneal [personal correspondence between M.B. Mount and A.W. Robertson, October 29, 1928], Bedford [personal correspondence to VA Chapters from M.B. Mount, February 18, 1929]). Additional chapters were located in Gordonsville, Nelson, Norfolk, Lynchburg, Altavista, Roanoke, Blacksburg, Appalachia, Abingdon, and Big Stone Gap (Newspaper clipping attached to a personal correspondence between M.B. Mount and Robertson, January 27, 1929).

Robertson often acted as the intermediary for IWLA chapters and lawmakers or Game Commission officials who could make wildlife management decisions. The chapters discussed proposed regulations, and chapter leaders provided local feedback directly to Robertson. In 1929, such correspondence addressed the destructive predatory behavior of an invasive carp species introduced from Europe (National Park Service, 2016). Carp introduction cost the IWLA and Game Commission thousands of dollars annually in their efforts to restock fish species that were impacted by carp predation. The IWLA's resolution stated:

> "Be it therefore resolved by the Izaak Walton League of America in convention that it is opposed to the propagation or stocking of carp and that same should not only be discontinued at once, but such efforts as are possible should be made to rid such streams and lakes as are chiefly adapted to game fish, of this objectionable and destructive variety of fish" (Personal correspondence between IWLA and all state Game and Fish Commissioners on June 27, 1928).

Later in Robertson's tenure as commissioner, he continued to receive input from IWLA chapters regarding contemporary issues. In 1932, the Charlottesville chapter commented on the length of Wild Turkey (*Meleagris gallopavo*) seasons:

> "I feel it would be desirable for citizens of Albemarle interested in an open season on turkeys to send us a petition indicating the length of the season desired. It is our intention of our commission to provide an open season, but we would welcome information concerning the local wishes on its length. It has been reported to me that the Izaak Walton local chapter of Charlottesville favors only two weeks." (Personal correspondence between Robertson and G.M. Dillard on May 10, 1932).

This working relationship and continuing correspondence between Robertson and various chapters of IWLA emphasized that changes in Virginia's game species laws began at the local level.

GRASSROOTS EFFORTS: OTHER EDUCATIONAL OUTLETS

As the IWLA chapters grew in number and participation across the Commonwealth, Robertson fielded many questions from citizens wishing to become more involved in education and conservation. In our reading of these letters, it became clear that citizens from Virginia and elsewhere sought advice about three main educational endeavors: 1) Maintaining populations of hunted species (how the citizen could contribute to conservation of a particular wild population), 2) educating citizens about hunting and fishing regulations (how to justify the laws and regulations), and 3) educational outreach by citizens (how the citizen could personally educate others).

1) Maintaining populations of hunted species

William C. Adams, Director of the Massachusetts Department of Conservation in 1928, visited Robertson in Virginia, seeking advice about game farms and fish hatchery operations. Robertson was closely involved with the Virginia State Game Farm that bred and released Northern Bobwhite (*Colinus virginianus*) for hunting. Adams wrote to Robertson, recognizing the farm's apparent successes.

> "This game farm and his [Mr. Coleman, the game warden who tended the farm] work is Virginia's one great contribution to the progress in wild life conservation. I say this not unmindful of the other splendid things which you are doing that have put Virginia in the forefront of conservation states. I think you ought to know this for it is a great help and inspiration to any of us in the work to have these opinions from the outside." (Personal correspondence between William C. Adams and Robertson, August 20, 1928).

In a similar vein, Ross Leffler (President) and other members of the Pennsylvania Board of Game Commissioners visited this farm to gain insight on Robertson's breeding methods:

> "First, let me state that from the standpoint of obtaining knowledge on your method, our trip was a complete success, as I earnestly believe that you have accomplished something in this line, which will take a great many years for other persons to accomplish. The efficient manner in which the farm is operated is to me a complete revelation, and I fully realize that only through management such as you have, has it been possible to achieve the remarkable results which you are able to show." (Personal correspondence between R. Leffler and Robertson, May 22, 1928).

2) Educating citizens about hunting and fishing regulations

In 1928, Robertson wrote to Fred Doellner, General Manager of the IWLA in Chicago, and described not only the importance of the rules pertaining to hunting but also the benefits of educating sportsmen on the reasons for the need for such regulations.

> "One great trouble that we are having is getting the sportsmen of Virginia to look upon wildlife conservation from the standpoint of the greatest good to the greatest number of people. Where game is plentiful in one county the hunters of that county want a longer season and a larger bag limit than their neighbors in adjoining counties have. In many other ways people in various sections of the state want special rights and privileges which may be desirable from their point of view but which are dangerous from the standpoint of constructive conservation thruout [sic] the state. Most of our troubles may be attributed to a lack of information concerning practical conservation and the only way by which our people may be reached with an educational program is through the establishment of League chapters in all sections of the state." (Personal correspondence between Robertson and Fred Doellner September 4, 1928).

Letters between Robertson and Mount emphasized the importance of working directly with the citizens, so that they understood the management decisions and supported the measures. Mount voiced his concern to Robertson about citizens, especially sportsmen, who were seemingly unaware of the management efforts by the IWLA and Game Commission. Individuals who lacked concrete information about these organizations were wary of what their local conservationists required of them through laws and regulations. However, because efforts to sustain wildlife actively involved these cautious individuals, they became more accepting of the laws to sustain or increase local wild populations. In Nelson County, fishermen living near the streams with stocked trout stated that they:

> "…were looking forward to their distribution; almost without exception they had agreed to refrain from fishing in those streams next year, if that should seem advisable, and to co-operate in every way in preventing illegal fishing. The fact that these mountain people have shown such an attitude is an indication that such work in fish culture has real educational value; I am satisfied that the establishment of nurseries in various parts of the State will help no little in creating interest among the people who live along the streams and that their interest will prove an important factor in restoring satisfactory fishing conditions." (Personal correspondence between Mount and Robertson, October 15, 1928).

3) Educational outreach by citizens

A Blackstone, Virginia game warden contacted Robertson in 1928 requesting approval and delivery of live quail [Northern Bobwhite] for use in his educational exhibit at the Nottoway County Fair. Robertson provided suggestions to educate the public on the importance of not only birds but also the dangers of *Felis catus* (Domestic or Feral Cat) as a predatory species. Robertson further recommended that the game warden supply posters that explained the dangers of both domestic and feral cats to wildlife, stating:

> "…that the average cat will kill fifty song birds a year, will hunt both day and night and recognizes neither closed seasons nor bag limits. Another poster should call for the protection of song birds, stating that insectivorous birds will eat 100 insects per day…In other words, the birds are the farmer's best friend…" (Personal correspondence between Robertson and W.L. Irby, Blackstone, Virginia game warden, September 19, 1928).

In its nascence, not all wildlife management tasks were completed directly by agency employees. Therefore, educated citizens were (and remain) an integral part of successful management. For example, correspondence documented back-and-forth conversations with a citizen, Mr. Gathright of Covington, Virginia who actively stocked fish (fingerlings) in local streams. Robertson's office provided both the young fish and written guidance to assist in their rapid growth.

> "…greatly appreciate your kindness in agreeing to plant some 200 rainbow in the headwaters of Smyth Creek. I know that this will be greatly appreciated by the local citizens interested in the restocking of this stream…We are requesting in our new budget the sum of $150,000 for fish culture work for the next thirty months and if wisely expended, this should produce some results…" (Personal correspondence between Robertson and Gathright, October 3, 1929).

Whether the initiation of conservation efforts originated by citizens reaching out to the Game Commission or the Game Commission working with individuals or groups of citizens, there was obvious support for conservation by both the agency and the end-users. Each constituency was dependent on the other for success, and this realization led to continued and specific correspondence and financial backing. The combined successes fueled continued efforts of citizen conservation efforts.

DIRECT EFFORTS TO RESTOCK NATIVE FAUNA

Robertson was trying to grow the conservation movement during a challenging time: the Great Depression. Further, populations of hunted and trapped species such as White-tailed Deer (*Odocoileus virginianus*), Wild Turkey, Black Bear (*Ursus americanus*), and American Beavers (*Castor canadensis*) had been depleted, and some nearly extirpated (R.L. Walker, VDGIF Agency Outreach, pers. comm., March 22, 2016). In his writings, Robertson worked closely with others to ensure the successful restocking of native species across the Commonwealth. One of Robertson's goals was population sustainability, i.e., stocking a sufficient number of individuals to ensure natural reproduction. One example was when Robertson arranged for the purchase of 100 wild turkeys by the Game Commission, which he sought to have distributed in Lynchburg (city) and Campbell County:

> "It is the desire of our Commission for these turkeys to be planted in sections suitable for their propagation and in which for some cause of [sic] another turkeys have become virtually exterminated. If possible, they should be released on some tract of 1500 or more acres where they can have suitable protection for at least two years in order to give them an opportunity to propagate." (Personal correspondence between Robertson and Mount, December 29, 1928).

The relationships Robertson formed with other conservationists helped achieve success in such stocking efforts. As part of a successful stocking program, Robertson advocated research in animal husbandry, general behavior, and disease control. Robertson received a copy of a letter to the Dean of the College of Agriculture, Virginia Polytechnic Institute (VPI), from M.G. Lewis, county agent of the Extension Service. The letter addressed the importance of research studies as suggested by Robertson:

> "I understand that Mr. Robertson is interested to the extent that he will arrange to furnish necessary breeding stock and what equipment is needed in addition to that already available on the V.P.I. poultry farm. It would undoubtedly be of value to students taking poultry husbandry to have the opportunity to learn a few of the essentials in this connection…" (Personal correspondence between Dean Price, the College of Agriculture, V.P.I. and M.G. Lewis, county agent of the Extension Service, January 11, 1929).

Robertson was not shy when it came to sharing his successes:

> "You may likewise by [sic] surprised to learn that three years ago there was not a deer in Roanoke County, but, owing to our restocking efforts, we not only have a large number in that

> County but they have extended from Roanoke into the adjoining Counties of Montgomery and Craig. We have likewise had good success with the deer released in Scott and Wise where there have been no deer for the past fifty years." (Personal correspondence between Robertson and G.M. Dillard, Scottsville, Virginia, November 21, 1932).

LOCAL AND STATE POLITICAL CONVERSATIONS

In 1928, the issue of stream pollution was a topic of discussion in the growing, vocal conservation community. At a time when many Virginia streams appeared to be devoid of aquatic life due to impacts from mining and heavy metals operations, Robertson played a substantial role in river restoration (R. L. Walker, VDGIF Agency Outreach, pers. comm., March 22, 2016). Mount alerted Robertson to the issue of "still slop pollution" (excesses from alcohol fermentation on a large scale; recall that this was the era of Prohibition). Mount was concerned that fish in the affected streams would be decimated. Robertson reached out to many government officials and conservationists to help gain control and resolve this issue. He responded to Mount:

> "…and have today written the Attorney General and the U.S. Director of Prohibition for Virginia, requesting that they each issue instructions to their leading officers not to pollute our mountain streams with confiscated liquor, beer and mash. I am glad that you brought this to my attention as it had never occurred to me before, but I can well understand how such a pollution would be entirely possible and result very detrimentally to the fish in small streams." (Personal correspondence between Robertson and Mount, June 15, 1928).

Several months later, Robertson organized a conference that included many industrial representatives as well as government leaders, with the goal of reaching a friendly resolution to the serious matter of stream pollution:

> "I am also requesting the paper mills at Buena Vista, Salem and Pearisburg, and the rayon plants at Roanoke, Covington and Waynesboro, and the chambers of commerce of the three last named cities to send representatives to this meeting. I have also requested the Governor to attend the conference, and likewise requested the following agencies to be represented: Commission of Conservation and Development, Commission of Fisheries, and the State Board of Health." (Personal correspondence between Robertson and Mount, August 18, 1928).

In Robertson's efforts to curb stream pollution, he wrote many letters to private citizens – many with roles in local governments – encouraging their personal involvement. He worked to raise funds and hired professionals to conduct surveys on the suspected polluted streams (i.e., providing scientific data to substantiate citizens' concerns).

> "…There is no doubt whatever about cooperation on the part of the University of Virginia and I talked with General Cocke this morning and he was delighted to make the V.M.I. laboratories [sic] available to us and said that we would have the hearty cooperation of the heads of the Chemistry, Biology and Engineering Departments at V.M.I." (Personal correspondence between Robertson and Richard Messer, Chief Sanitary Engineer, Dept. of Health, Richmond, VA, April 4, 1929).

> "…Mr. Harry A. Bailey who has been employed be [sic] the co-operative stream pollution committee to conduct a survey of our streams. Mr. Bailey will use the laboratories of the V.M.I…" (Personal correspondence between M.B. Mount and Rev. James J. Murray of Lexington IWLA Chapter, April 25, 1929).

> "…Fortunately, the committee of which I am chairman has been able to secure the services of a Mr. Bailey, formerly of Minnesota, and he will be in charge under the immediate supervision of the Chief Sanitary Engineer of our State Board of Health of the technical end of our stream pollution work." (Personal correspondence between Robertson and Hon. William Knox, Manager, Nimrods of America, April 30, 1929).

Although Robertson could secure assistance from dependable citizens to conduct pollution surveys, and secure them working spaces in a university laboratory (in this case, at Virginia Polytechnic Institute), one limitation to his Commissioner position was his inability to change the laws. Robertson was the first to point out the deficiencies in laws and law enforcement, and indicated an earnest desire to change them:

> "...I can say definitely, however, two thinks [sic] in which we need your help: viz, (1) the raising of an adequate budget to continue the work for two years after February, 1930; (2) the strengthening of the state pollution law… I do not yet know what this budget will amount to but it will probably be not less than $20,000… Section 3196 which carries the penalty provides for a fine of not less than five nor more than two hundred and fifty dollars. A fine of five dollars for a pollution which may cause the destruction of thousands of fish is absolutely ridiculous. To investigate and ascertain the facts concerning the pollution of the Covington paper mill in the James river, for instance, means an expenditure on our part of from five to ten thousand dollars. This investigation has to be made before there could be a successful prosecution under Section 3195 since the court would require us to establish beyond a reasonable doubt both the nature and the effect of the pollution in question and this effect was injurious to fish or fish spawn. After making such an investigation, let us assume that the paper mill would refuse to take any steps to prevent their pollution. We would then have a warrant sworn out before a justice of the peace who upon proof of the law violation could impose a fine of only five dollars, which would relieve the offending company from all further responsibility for any violations prior to the issuance of that particular warrant. You can therefore well see how a manufacturing interest inclined to ignore and violate the law could exhaust the resources of the state in prosecutions of this character by the payment of small fines..." (Personal correspondence between Robertson and Max Fleischer of the Gordonsville IWLA Chapter and general superintendent and secretary of Inglewood Farms, Inc., August 19, 1929).

In situations like this, Robertson saw the "ridiculous" penalties that current laws impose, but as Chairman of the Game Commission, he lacked the ability to directly change the current laws. Perhaps it was frustrations like this that spurred Robertson to move towards an elected position, where he could effectively change the laws to better sustain wildlife.

With this state experience under his proverbial "belt," Robertson was elected to the United States House of Representatives in November 1932. From 1933-1946, he served as Chairman of the Committee on Wildlife Conservation. The skills acquired through his state appointments and collaborations fostered through his correspondence would serve him well on the national stage (Heinemann, 2014).

ROBERTSON'S CONTINUING LEGACY

Today, it is widely acknowledged that A. Willis Robertson's most sustaining contribution to conservation was the Federal Aid in Wildlife Restoration Act, also known as the Pittman-Robertson Act (1937). VDGIF historian R. L. Walker (pers. comm., March 22, 2016) believes that one of the main reasons that the Pittman-Robertson Act continues to benefit conservation is because of the following clause in the act: "…and which shall include a prohibition against the diversion of license fees paid by hunters for any other purpose than the administration of said state fish and game department…" Wildlife Restoration Act (Pittman-Robertson PR) of 1937.

Representative Robertson co-sponsored this bill, which imposed an 11% tax on sporting arms, ammunition, and archery equipment, and a 10% tax on handguns (Federal Funding for Fish and Wildlife, 2015). This brought in significant funds (e.g., $484,765,728 reported in 2009; Andrew Loftus Consulting, Southwick Associates, Inc. 2011) that provides assistance to state projects for purchasing land, improving existing lands, and supporting wildlife research (Our Wildlife Legacy, 2012). From 1939-2014, this act has collected more than 8 billion dollars, which, in part, has led to the purchase of more than 16,000 km^2 of wildlife-enhancing habitat, and establishing private landowner agreements to help manage 160,000 km^2 across the nation (The Wildlife Society, 2014). In Virginia, these funds bolstered early restoration efforts for White-tailed Deer, specifically providing additional support to purchase and reintroduce these deer into the western portion of the Commonwealth in the late 1930s and early 1940s (Gooch, 2001). They also have helped restore Northern Bobwhite in the Commonwealth (Stewart, 2012). More recently, allotted funds from this tax diverted more than 7 million dollars in Fiscal Year 2012 (U.S. Fish and Wildlife Service, 2013). Money from this Act fully funds state hunter education programs, encouraging safe and ethical decisions while hunting (Gooch, 2001).

This legacy is founded on Robertson's experience in grassroots education, commitment to citizen education, and fostering an understanding and respect for the wildlife around them. Robertson's correspondence reveals positive conservation efforts on local and state levels. Our investigation of just a fraction of the 40,000 documents from the Robertson archives revealed a glimpse into the field of conservation in its infancy.

Currently, the 40,000 documents held by the LOV are not in any digital format, nor are they accessible by the general public. The 3,100 papers we reviewed had been digitally scanned and were available for viewing because a platform was available. We recommend that future efforts at the LOV focus on digitizing all 40,000 documents and making them accessible to researchers.

ACKNOWLEDGEMENTS

We are grateful for the assistance of R. Lee Walker and Virginia Shepherd for their initial sharing of archival papers. Walker provided additional resources for the preparation of this manuscript. Scott Klopfer, Conservation Management Institute, initiated this project through the Virginia Chapter of The Wildlife Society and was the impetus for fully scanning the 3,100 documents.

LITERATURE CITED

Andrew Loftus Consulting, Southwick Associates, Inc. 2011. Financial returns to industry from the Federal Aid in Wildlife Restoration Program. Wildlife Restoration ROI Report. http://www.fishwildlife.org/files/WildlifeRestoration-ROI-Report_2011.pdf (Accessed 15 February 2016).

Federal Funding for Fish and Wildlife. 2015. Connecticut Department of Energy & Environmental Protection. Retrieved from http://www.ct.gov/deep/cwp/view.asp?a=2723&q=326164 (Accessed 15 February 2016).

Gooch, B. 2001. The Evolution of a Wildlife Agency. Virginia Department of Game and Inland Fisheries, Richmond, VA. 147 pp. (Print copy available in library of VDGIF Richmond office)

Heinemann, R. L. 2014. A. Willis Robertson (1887–1971). *In* Encyclopedia Virginia. http://www.EncyclopediaVirginia.org/Robertson_A_Willis_1887-1971 (Accessed 15 February 2016).

Izaak Walton League of America (IWLA). 2016. About Us. http://iwla.org/aboutus (Accessed 10 March 2016).

National Park Service. 2016. History of Common Carp in North America. https://www.nps.gov/miss/ learn/nature/carphist.htm (Accessed 10 March 2016).

Our Wildlife Legacy. 2012. Wildlife Journal (Sept/Oct issue). http://www.wildlife.state.nh.us/pubs/documents/samples/wildlife-legacy.pdf (Accessed 14 February 2016).

Stewart, D. 2012. Conservation: A law that keeps on giving. National Wildlife Magazine, January 2012. https://www.nwf.org/News-and-Magazines/National-Wildlife/Animals/Archives/2012/Pittman-Robertson-Act.aspx (Accessed 3 August 2017).

The Wildlife Society. 2014. Policy Brief Series: Federal Aid in Wildlife Restoration Act. 2 pp. http://wildlife.org/wp-content/uploads/2014/11/TWS_PolicyBrief_Pittman-Robertson-Act_FINAL_Oct-2014.pdf (Accessed 3 August 2017).

Thompson, J. L., & K. E. Francl-Powers. 2014. A brief history of terrestrial game species management in Virginia: 1900-present. Banisteria 41: 59-66.

U.S. Fish and Wildlife Service. 2013. FY2013 budget justification: Pittman-Robertson Wildlife Restoration. https://www.fws.gov/budget/2013/PDF%20Files%20FY%202013%20Greenbook/24.%20Wildlife%20Restoration.pdf (Accessed 3 August 2017).

Miscellanea

Reviews

Larvae of the Southeastern USA Mayfly, Stonefly, and Caddisfly Species (*Ephemeroptera, Plecoptera, and Trichoptera*), edited by John C. Morse, W. Patrick McCafferty, Bill P. Stark, & Luke M. Jacobus. 2017. Biota of South Carolina Volume 9. Clemson University Public Service Publishing, Clemson, SC. 482 pp. Spiral bound softcover; $40. Available for purchase from Public Service Bulletin Room, 96 Poole Agricultural Center, Clemson University, Clemson, SC 29634-0129 or online at https://secure.touchnet.net/C20569_ustores/web/store_cat.jsp?STOREID=168&CATID=298&SINGLESTORE=true.

This is the ninth volume in the Biota of South Carolina series edited by Al Wheeler, who is also an Associate Editor of *Banisteria*. Seven of the previous volumes treated various beetle groups and the other concerned the plant genus *Rhynchospora* (beakrushes or beaksedges). About half of these excellent monographs were reviewed in previous issues of this journal.

The present volume treats two relatively small insect orders, the mayflies (Ephemeroptera) and stoneflies (Plecoptera), and the larger order (Trichoptera) containing the caddisflies. Collectively, these groups are referred to as EPT (first initial of order names), and have been used for decades in water quality monitoring assessments and stream ecology studies owing to the pollution sensitivity and functional roles of various taxa. Mayflies and caddisflies can be found in both lotic and lentic waters, whereas stoneflies are confined to lotic waters such as spring runs, streams, and rivers. Beginning in the mid-1970s, several major publications treated the EPT fauna of North America at the genus level, including Edmunds et al. (1976) for mayflies and Wiggins (1977; second edition published in 1996) for caddisflies, and later Stewart & Stark (1988; reprinted in 1993 and second edition published in 2002) for stoneflies. Merritt et al. (2008), now in its fourth edition, covers all aquatic insect groups, with keys to the genus level (family level in first edition, 1978). However, as one might expect, biologists working in the eastern United States often desire more regional works that exclude western taxa and thus simplify the identification process. To this end, Brigham et al. (1982) published a detailed guide to the aquatic insect fauna of the Carolinas that included keys to species, and Peckarsky et al. (1990) prepared a guide to the freshwater macroinvertebrates of northeastern North America (keys to genus).

There is increased interest in improving the level of taxonomic identification in biomonitoring surveys and ecological studies beyond that of family and genus to the individual species (Lenat & Resh, 2001). All of the water quality monitoring programs in Virginia of which I am aware (e.g., U.S. Forest Service, U.S. National Park Service, Virginia Commonwealth University's Healthy Waters Program, Virginia Department of Environmental Quality, etc.) do not identify their aquatic insect samples beyond the level of family or genus, whereas biologists at the North Carolina Department of Environmental Quality are actively seeking species-level identifications whenever possible (e.g., Beaty, 2015).

The purpose of this new publication is to help facilitate species level identifications of EPT specimens collected in Region 4 of the U.S. Environmental Protection Agency (EPA), an 8-state area that extends from Florida west to Mississippi, and north to Kentucky and North Carolina. Given this coverage, it seems reasonable to assume that many of Virginia's EPT species are included in the identification keys.

The Biota of South Carolina volume on the EPT fauna of southeastern United States is a major contribution that will be used by many biologists and serious amateur naturalists. This region contains high species diversity and both regional and local endemism, especially in the southern Appalachian Mountains. The authors are leading experts on these insect groups and have drawn upon their decades of field and laboratory experience to produce a very valuable work. The extensive, profusely illustrated identification keys are mostly applicable to mature larvae/nymphs. I have not had an opportunity to test the keys with specimens of known identity, but many students of the authors have done so over multiple decades, thus increasing the likelihood of their reliability.

Following a very brief introductory chapter, there are separate chapters for mayflies (146 pages), stoneflies (87 pages), and caddisflies (195 pages). Each chapter has its own bibliography. The volume concludes with a 40-page taxonomic index that includes both [genus species] and [species, genus] entries. The format of the taxonomic chapters is similar, including introductory text (mostly devoted to discussions of morphology), a checklist of all species recorded from the 8-state area plus adjacent states (including Virginia), identification keys, and a bibliography. Figures are placed on the page opposite the corresponding text in the dichotomous key rather than at the end of each chapter.

In each chapter, couplets and cited figures in the identification keys are numbered sequentially from beginning to end. The format of the keys is variable, with those for stoneflies and caddisflies proceeding to families first then later to genus/species, whereas in the

mayfly key each family is keyed out in its entirety and then the key proceeds to the next family. Some of the couplets end at species groups/complexes because of unresolved taxonomic or identification issues. A few species key out more than once owing to variable characters. The authors note that some portions of their keys should be considered provisional due to the small sample sizes of preserved larvae that were available for study. For some stonefly genera (e.g., *Allocapnia*), preemergent larvae in which some adult male characters are expressed are desired for identification purposes. For other species, one must rear the larvae to the adult stage for positive identification. All authors stress the need for continued collecting and rearing of larvae to associate immature life history stages with the adult form of the species. The use of DNA studies to match adults and unknown larvae is also recommended in the caddisfly chapter, but applies to all three groups. The keys sometimes contain notes on habitat, ecological niche (e.g., shredders, predators), or briefly discuss known but undescribed species.

The quality of the figures is generally good, but I think some figures should have been larger and others smaller. Curiously, there is no labeled, basic anatomical drawing of a mayfly nymph such as in Edmunds et al. (1976). There are good illustrations of basic caddisfly larval anatomy, especially head parts and associated characters, as well as thoracic setae. Labeled dorsal and ventral illustrations of a typical stonefly nymph are provided. The 468 figures in the mayfly chapter are highly variable, with some being very detailed and exquisite, whereas others are simple line drawings. Some of these are original drawings but others were borrowed from published sources. A few of the mayfly figures are "pixelated" or slightly out of focus (e.g., 2.344-2.345, 2.380). Most of the 327 figures in the stonefly chapter are original illustrations and of consistently good quality. The caddisfly chapter contains 740 figures (1 in partial color) of consistently good quality, including numerous illustrations of head capsules and larval cases.

The species checklists include all EPT species that have been recorded from EPA Region 4, plus those known from adjacent states (including Virginia) and therefore likely or potentially occurring in this 8-state region. There are some minor inconsistencies in the symbology used in the species list for mayflies vs. stoneflies and caddisflies, and, oddly, the text font of the mayfly list differs from that of the rest of the entire volume. I noted a few minor formatting errors in the checklists (e.g., some synonyms are not indented; odd spacing of several original genus names). The stonefly and caddisfly checklists are very detailed and useful, whereas the mayfly list contains names and authors only. For each species of stonefly and caddisfly, the entry lists its state and provincial distribution in North America (repeated unnecessarily for each species of stonefly in the identification keys), author and date, original genus name if now different, and synonyms (with first reviser for each). Readers are referred to the Mayfly Central website (McCafferty & Jacobus, 2017) for original citations, synonymies, etc. of that group and to the paper by McCafferty et al. (2010) for the state by state distribution of each species within EPA Region 4; this paper also includes records for Arkansas, Louisiana, Virginia (170 species), and West Virginia, but there is still no published or online source that summarizes the complete state and provincial distributions of North America mayflies. I would have preferred inclusion of the EPA Region 4 state records in the mayfly checklist.

For all three insect orders, there have been many changes in taxonomy (especially mayflies) and new species described since the publications of Edmunds et al. (1976), Wiggins (1977), Brigham et al. (1982), and Stewart & Stark (1988). Some genera are currently in need of revision to confirm the validity of described taxa and to name others lacking descriptions. New species continue to be found in the region, as well as in nearby Virginia (e.g., Verdone & Kondratieff, 2016).

Readers naively expecting to find the larvae of all regional species of EPT included in the identification keys will be sorely disappointed. This is entirely due to the incomplete state of our current knowledge despite much progress in the past half century. As stated by author Stark in his introduction to the stonefly chapter: "Literature for species identification of most North American stonefly larvae does not exist and larval stages for the majority of species are still unassociated or undescribed." By contrast, the larvae of less than a handful of North American Odonata (dragonflies and damselflies) are unknown (Needham et al., 2000; Westfall & May, 1996; and subsequent editions of both).

Among EPT taxa, the immature stages of mayflies are by far the best known. In this volume, 287 of the 302 (95%) regional species are included in the keys; larvae are unknown for the remaining 15 (3 are thought to be recently extinct). Only 3 of these 15 species (*Iswaeon rubrolaterale*, *Rhithrogena anomala*, and *Siphloplecton costalense*) occur in Virginia, therefore the keys include 98.2% of the state's known mayfly fauna. For stoneflies, slightly more than half (162 of 294; 55%) of the regional species are included in the keys owing to the fact that many larvae are unknown/undescribed or unassociated with adults. The corresponding figure for caddisflies is even lower – only 309 of the 663 (47%) regional species are included in the keys, once again because larvae of the remainder are undescribed or unassociated.

The stonefly checklist records 175 species from Virginia as compared to the updated figure of 186

reported by Kondratieff et al. (2017; several subsequent additions are known including undescribed species, B. C. Kondratieff and C. J. Verdone, unpubl. data). Of the 175 species, nearly two-thirds (115, or 65.7%) are included in the larval keys (Table 1).

Table 1. Proportion of species in each stonefly family recorded from the southeastern United States (and Virginia) that are included in the larval keys in McCafferty et al. (2017); data were tallied from the species checklist.

Plecoptera	**SE US fauna**		**Virginia fauna**		
Family	**Yes**	**No**	**Yes**	**No**	**%**
Capniidae	13	26	12	10	54.5
Leuctridae	9	24	6	9	40.0
Nemouridae	15	9	12	4	75.0
Taeniopterygidae	15	1	14	0	100
Chloroperlidae	21	14	14	9	60.9
Peltoperlidae	1	9	0	5	0
Perlidae	40	27	25	12	67.6
Perlodidae	39	25	27	11	71.1
Pteronarcyidae	6	0	5	0	100
Total	159*	135	115	60	65.7

*Text cites a figure of 162.

For some stonefly genera (e.g., *Pteronarcys*, *Yugus*), all of the regional species are included in the identification keys, but for others few to none of the larvae are known. For example, only 11 of 37 regional species of *Allocapnia* are included in the key, and none of the seven species of *Tallaperla* that occur in Virginia. Likewise, only 6 of 20 Virginia species of *Perlesta* are potentially identifiable as nymphs, although adults are preferred for positive identification. In the genus *Isoperla,* 22 new species were recently described based on adults but there were no accompanying larval descriptions (Szczytko & Kondratieff, 2015). Consequently, only 16 of the 41 regional species (42 with the addition by Verdone & Kondratieff, 2016) are included in the key; however, the authors note that state biologists in North Carolina are working to associate and describe more of them. For the Virginia endemic *Isoperla major* the key states that this species emerges in August and September, but new collections reveal that its flight period begins much earlier than that (B. C. Kondratieff and C. J. Verdone, unpubl. data).

A few stoneflies are included in the keys even though their larvae are unknown. For example, the two eastern US species of *Megaleuctra* are keyed out by geographic range (both species reach their distributional limits in Virginia, but in the northern vs. southern Blue Ridge Mountains, respectively), presumably on the basis of characters possessed by other members of this genus that inhabit western North America. The larva of "*Zapada* species A" is unknown, but it is included in the key based on the assumption that the distinctive cervical gills of the adults are also present in the larvae. This species, which ranges north as far as the Mount Rogers area of Virginia, was recently described as *Zapada fumosa* Baumann and Grubbs in Grubbs et al. (2015). This paper was included in reference list of the stonefly chapter but the specific epithet was not used in the species list or key.

Knowledge of the immature stages of caddisflies is highly variable among the different families and genera (Table 2). For some families (e.g., Brachycentridae, Odonotoceridae), all of the southeastern species are included in the larval identification keys. By contrast, the larvae of less than ten percent of the microcaddisflies (Hydroptilidae) and the family Lepidostomatidae are described or associated with adults. All 13 of the Virginia species of *Neophylax* are included in the keys, as are 14 of 15 species of *Pycnopsyche* and 17 of 22 species of *Rhyacophila*.

Table 2. Proportion of species in selected caddisfly families and genera recorded from the southeastern United States that are included in the larval keys in McCafferty et al. (2017); data were tallied from the species checklist.

Trichoptera	**Larval keys to SE US fauna**			
Family/genus	**Yes**	**No**	**Total**	**%**
Brachycentridae	20	0	20	100
Glossosomatidae	11	28	39	28.2
Agapetus	5	22	27	18.5
Goeridae	6	1	7	85.7
Hydropsychidae	58	32	90	64.4
Hydroptilidae	15	168	183	8.2
Lepidostomatidae	1	32	33	3.0
Leptoceridae	67	17	84	79.8
Limnephilidae	30	8	38	78.9
Pycnopysche	15	2	17	88.2
Odontoceridae	8	0	8	100
Phryganeidae	5	6	11	45.5
Polycentropodidae	10	33	43	23.3
Rhyacophilidae (*Rhyacophila* spp.)	22	10	32	68.8
Thremmatidae (*Neophylax* spp.)	16	2	18	88.9

The caddisfly checklist records 361 species from Virginia, omitting the eight additions reported by Flint (2014; several subsequent additions are known, O. S. Flint, unpubl. data). Of the 361 species, almost two-thirds (225, or 62.3%) are included in the larval keys of this volume. This proportion is similar to the figure for Virginia stoneflies and both values are higher than those cited above for the entire southeastern US fauna.

Finally, a few brief notes about the volume's production. The format is 8.5 x 11 inches with a plastic spiral binding that will hopefully hold up over time and heavy use. The paper quality appears to be good (thick, not slick). The text is set in 12-point Times New Roman

font (except for the mayfly species list), which seems a bit larger than necessary, but makes for easy reading. I only noted a few typographical errors and minor formatting problems. There is abundant blank white space on numerous pages in the keys, which might have been avoided by using a smaller font and rearranging the figures, thus reducing the overall size of the volume (482 pages weighing about 3.5 pounds).

In summary, I recommend this volume highly to anyone with an interest in aquatic insects, biomonitoring programs, and ecological research of aquatic habitats in eastern North America. Although the identification keys are quite technical, serious amateur naturalists may also find much of value in this volume. Perhaps they can even contribute to our knowledge of EPT taxa by making collections or attempting to rear larvae and associate them with adults. The volume's authors note that future updates to this work are more likely to appear on a website than through publication of a revised edition.

Literature Cited

Beaty, S. R. 2015. The Plecoptera of North Carolina: A biologist's handbook for the identification of stonefly nymphs with standard taxonomic effort levels. Version 4.0. North Carolina Department of Environmental Quality, Division of Water Resources, Biological Assessment Branch. Raleigh, NC. 91 pp.

Brigham, A. R., W. U. Brigham, & A. Gnilka (editors). 1982. Aquatic Insects and Oligochaetes of North and South Carolina. Midwest Aquatic Enterprises, Mahomet, IL. [837 pp.]

Edmunds, G. F., Jr., S. L. Jensen, & L. Berner. 1976. The Mayflies of North and Central America. University of Minnesota Press, Minneapolis, MN. 330 pp.

Flint, O. S. 2014. Caddisfly species new to, or rarely recorded from, the state of Virginia (Insecta, Trichoptera). Banisteria 43: 89-92.

Grubbs, S. A., R. W. Baumann, & A. Sheldon. 2015. A review of eastern Nearctic *Zapada* (Plecoptera: Nemouridae) with a new species from the Great Smoky Mountains. Freshwater Science 34: 1312-1323.

Kondratieff, B. C., C. J. Verdone, & S. Roble. 2017. New records of stoneflies (Plecoptera) from Virginia, U.S.A. Perla 35: 22-27.

Lenat, D. R., & V. H. Resh. 2001. Taxonomy and stream ecology – The benefits of genus- and species-level identifications. Journal of the North American Benthological Society 20: 287-298.

McCafferty, W. P., & L. M. Jacobus. 2017. Mayfly Central. http://www.etm.purdue.edu/mayfly/index/.php

McCafferty, W. P., D. R. Lenat, L. M. Jacobus, & M. D. Meyer. 2010. The mayflies (Ephemeroptera) of the southeastern United States. Transactions of the Entomological Society of America 136: 221-233.

Merritt, R. W., K. W. Cummins, & M. B. Berg. 2008. An Introduction to the Aquatic Insects of North America. 4th Edition. Kendall Hunt Publishing Company, Dubuque, IA. 1,158 pp.

Needham, J. G., M. J. Westfall, Jr., & M. L. May. 2000. Dragonflies of North America. Scientific Publishers, Gainesville, FL. 939 pp.

Peckarsky, B. L., P. R. Fraissinet, M. A. Penton, & D. J. Conklin, Jr. 1990. Freshwater Macroinvertebrates of Northeastern North America. Comstock Publishing Associates, Cornell University Press, Ithaca, NY. 442 pp.

Stewart, K. W., & B. P. Stark. 1988. Nymphs of North American Stonefly Genera (Plecoptera). The Thomas Say Foundation, Volume XII. Entomological Society of America, Lanham, MD. 460 pp. [reprinted in 1993 by University of North Texas Press]

Szczytko, S W., & B. C. Kondratieff, 2015. A review of the eastern Nearctic Isoperlinae (Plecoptera: Perlodidae) with the description of twenty-two new species. Monographs of Illiesia 1: 1-289.

Verdone, C. J., & B. C. Kondratieff. 2016. A new species of *Isoperla* Banks (Plecoptera: Perlodidae) from the Appalachian Mountains, Virginia and West Virginia. Illiesia 12: 74-85.

Westfall, M. J., Jr., & M. L. May. 1996. Damselflies of North America. Scientific Publishers, Gainesville, FL. 649 pp.

Wiggins, G. B. 1977. Larvae of the North American Caddisfly Genera (Trichoptera). University of Toronto Press, Toronto, Ontario, Canada. 401 pp.

Steven M. Roble
Virginia Department of Conservation and Recreation
Division of Natural Heritage
600 E. Main Street
Richmond, VA 23219

Reports

1. Minutes of the Executive Committee of the Virginia Natural History Society Meeting of December 10, 2016

The 2016 meeting of the Executive Committee of the Virginia Natural History Society was called to order by President Michael Lachance at 1:05 PM on December 10, 2016 in Settle Hall at Hampden-Sydney College, Hampden-Sydney, Virginia. In attendance were President Michael Lachance, Vice-President Alfred Gardner, Editor Steve Roble, Councilor Paul Marek, Secretary/Treasurer Rachel Goodman, and Past Presidents Ralph Eckerlin and Barry Knisley.

There was discussion of the Secretary/Treasurer's report. Rachel Goodman agreed to send reminder letters to the non-renewing members and institutions from 2016. She will also send out the usual membership renewal with issue No. 47 of *Banisteria*. Also, she will draw attention to the free membership for high school, undergraduate, and graduate students who are nominated by an advisor/teacher. Goodman notes that the HSC Business Office cannot accept online payments for membership.

Steve Roble presented the Editor's report. *Banisteria* No. 47 is expected to be published and mailed in January/February of 2017. The updated bylaws will be published in this issue. Potential contents for *Banisteria* issues No. 48 and No. 49 (to be published in 2017) were presented. Transition of the journal to a new editor, Todd Fredericksen, will commence with issue No. 51. The submission and review process was discussed; two outside reviewers are assigned to each manuscript. Historically, Associate Editors have had a small, supportive role in the production of the journal, but they could take on enhanced responsibility in the future depending on the preference of the new editor.

There are more than 100 copies of the special cave issue of *Banisteria* (No. 42) remaining. The council suggested that we 1) lower the price of this issue online, and/or 2) distribute or sell these copies to various societies, caving businesses, and state parks.

EBSCO Information Services has invited the society to store and distribute the content of *Banisteria* online. Currently the only indexing service for the journal is Zoological Record, and this only carries a subset of *Banisteria* publications. Paul Marek also suggested an online service at Virginia Tech which would publish and index *Banisteria* articles. The Council unanimously voted in favor of using the EBSCO service.

The VNHS website will be updated to include the following notices: 1) Research in *Banisteria* submissions should comply with animal care and use guidelines for appropriate major societies; 2) Guidelines for collecting biological specimens and the disposition of this voucher material, and the importance of this work, may be published in an upcoming issue of *Banisteria*.

Paul Marek reported on the newsletter, of which one issue was sent out in 2016. Suggestions for future content were solicited. It was noted that VNHS was founded in 1992, and the silver anniversary will be in 2017.

The Council discussed having an online discussion forum and/or Doodle polls to get feedback from members and organize events and gatherings.

The Council discussed upcoming changes in VNHS membership. Nominations were submitted for the offices of Vice-President (Nancy Moncrief) and Councilor for 2017-2020 (Kal Ivanov). Rachel Goodman agreed to continue serving as Secretary/Treasurer if re-elected. More nominations will be solicited from the society via email. Ballots will be distributed with the next issue of *Banisteria*, along with the dues renewal forms.

The meeting adjourned at 3:10 PM.

Respectfully submitted,
Rachel M. Goodman
Secretary/Treasurer

2. Secretary-Treasurer's Report

As of November 3, 2017, the society has 68 members, including 12 institutions. This is a significant decline from last year's membership of 95 members (13 institutions) in December 2016. In previous years, 95-127 members have been recorded at this time of year. The current bank balance is $15,787.00, up from $14,210.51 in December 2016.

The members of the society's Executive Committee and their term expiration dates are as follows:

President: Al Gardner (December, 2018)
Vice President: Nancy Moncrief (December, 2018)
Secretary-Treasurer: Rachel Goodman (December, 2020)
Councilors: Paul Marek (December, 2017), Chris Milensky (December, 2018), Kal Ivanov (December, 2020)
Editor of *Banisteria*: Steve Roble
Webmaster: vacant
Past Presidents: Ralph Eckerlin, Todd Fredericksen, Michael Lachance

Respectfully submitted,
Rachel M. Goodman
Secretary/Treasurer

3. Webmaster's Report

John White, VNHS Webmaster for the past 16 years, stepped down from this position in October. The society is seeking another member to fill this important role. If you are interested and possess the necessary skills, contact President Al Gardner at gardnera@si.edu.

4. Editor's Report

This belated first issue of *Banisteria* for 2017 marks 25 years since the society published the first issue of this journal to commemorate the 300th anniversary of the accidental death of John Banister (ca. 1650-1692), Virginia's first university-trained naturalist. Cumulatively, nearly 3,000 pages of the journal, containing 380 papers written by several hundred authors, have been published by the society. This is a significant accomplishment considering our meager beginnings. I look forward to the next quarter century of continued productivity.

The society recently entered into an agreement with EBSCO Information Services to make digital copies of current *Banisteria* papers available to their many academic library subscribers. This should help to make the journal and its contents more widely known.

I am currently working on the second issue of *Banisteria* for 2017 and anticipate that it will be published early next year. More submissions are always needed for future issues of the journal because there is rarely a backlog of accepted manuscripts, so please consider submitting a paper, note, biography, or historical contribution concerning the natural history of Virginia. Consult the Instructions for Authors posted on the society's website (also printed in *Banisteria* No. 47) before preparing your paper.

Finally, I would like to personally thank John White for sharing his expertise, creativity, photographs, and many hours of volunteer time with the society in his role as webmaster during the past 16 years.

Respectfully submitted,
Steve Roble
Editor, *Banisteria*

Announcements

1. News of Members

Michael Kosztarab, who played a leading role in the formation of the Virginia Natural History Society and served as its first President (1992-94), celebrated his 90th birthday on July 7, 2017. He is currently an Honorary Councilor and remains very supportive of the society.

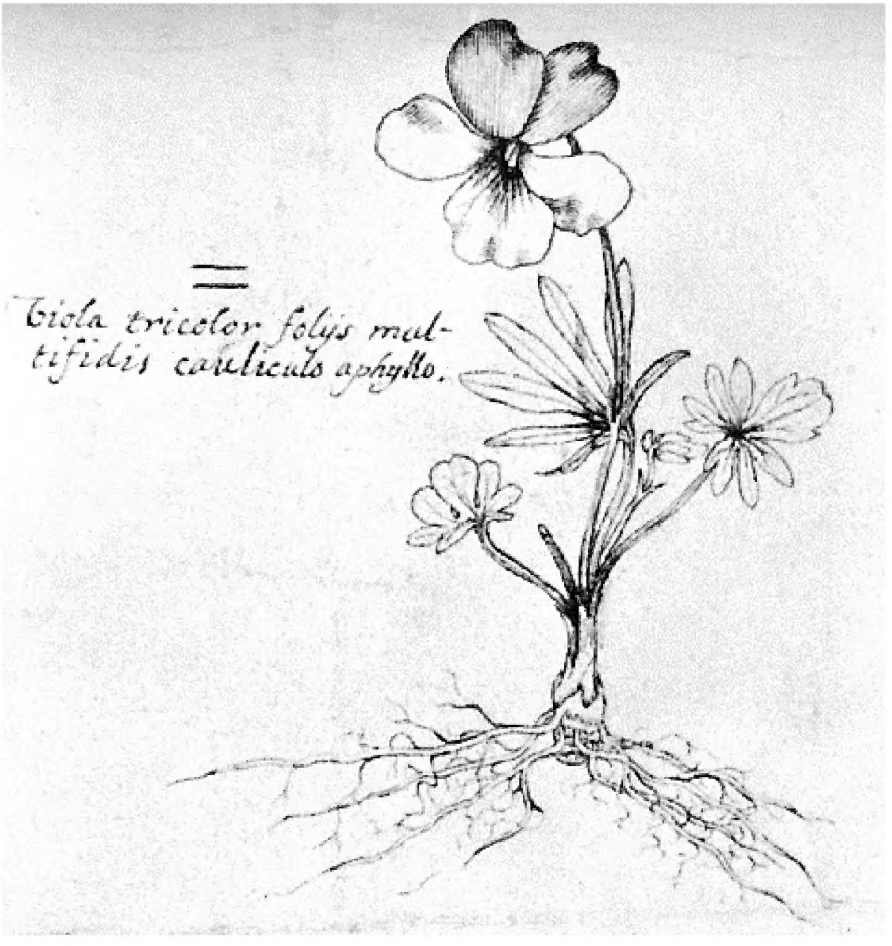
2. Recent publication of interest

Kleopfer, J. D., M. J. Pinder, & J. C. Mitchell. 2017. A Guide to the Snakes and Lizards of Virginia. Special Publication Number 2, 2nd edition. Virginia Department of Game and Inland Fisheries, Richmond, VA. 72 pp. $10. Available for purchase from the agency's online store at: http://www.shopdgif.com/category.cfm?uid=28420

This popular guide includes more than 170 photos covering the ecology, distribution, and conservation of Virginia's 32 species of snakes and nine species of lizards. It is an expanded version of the agency's previous guide to snakes, but now includes lizards and has more technical information and new photos.

Student Membership Incentive

Recognizing that students interested in natural history represent the main pool of prospective future members of the Virginia Natural History Society, the Executive Committee of the Society is soliciting nominations from our members for a **free one-year membership in the Society** to selected college, university, and high school students. We believe that receiving this membership will make more students aware of the Society and appreciate the benefits of continued membership. Nominees should be undergraduate or graduate students at a college or university in Virginia, or outstanding high school students, who are particularly interested in natural history. Nominators should be members of the Society and provide the following information for up to three students: Name, institution, mailing address, e-mail address, and a short paragraph describing the students' interests in and activities related to Virginia natural history. Nominations should be sent to the Secretary-Treasurer, Rachel Goodman at rgoodman@hsc.edu.



Viola pedata Linnaeus (Bird's-foot Violet)

Original drawing by John Banister, sent to Bishop D. H. Compton in 1689. Figure 58 in folio in Sir Hans Sloane's MS 4002 in the British Museum. Photocopy courtesy of Joseph and Nesta Ewan.

Virginia Natural History Society

http://virginianaturalhistorysociety.com/

General Information

The Virginia Natural History Society (VNHS) was formed in 1992 to bring together persons interested in the natural history of the Commonwealth of Virginia. The VNHS defines natural history in a broad sense, from the study of plants, animals, and other organisms to the geology and ecology of the state, to the natural history of the native people who inhabit it. The goals of the VNHS are to promote research on the natural history of Virginia, educate the citizens of the Commonwealth on natural history topics, and to encourage the conservation of natural resources.

Dissemination of natural history information occurs through publication of the journal *Banisteria*, named for John Banister (1650-1692) who was the first university-trained naturalist to work in Virginia. The first issue was published in 1992, and the journal is published twice per year in spring and fall. Articles cover a wide array of subjects, and prospective authors are encouraged to submit manuscripts on any aspect of natural history in Virginia; papers may pertain to Virginia or regional archaeology, anthropology, botany, ecology, zoology, paleontology, geology, geography, or climatology. Book reviews, biographies, obituaries, and historical accounts of relevance to natural history in Virginia also are welcomed. Manuscripts are peer-reviewed for suitability and edited for inclusion in the journal.

Page charges ($20/page) are waived if the sole or first author is a VNHS member. All authors must pay $75/page if they desire color printing of figures. The society's website contains detailed instructions for prospective authors and PDF reprints of all *Banisteria* articles that are at least one year old.

Memberships

The VNHS is open to anyone with an interest in natural history and welcomes participation by all members in society activities and efforts to promote education and conservation. Membership includes a subscription to *Banisteria* and invitations to periodic symposia and field events. Annual dues for members are $20 (per calendar year); library subscriptions are $40 per year. Checks or money orders should be sent to the Secretary/Treasurer, who also has most back issues of *Banisteria* available for sale. The VNHS is a tax-exempt, nonprofit, society under Section 501(C)3 of the IRS. We welcome donations to support our mission in Virginia.

Virginia Natural History Society

Application for Membership

Name _____

Address _____

_____

_____

Zip Code _____

Phone _____

Email _____

Area(s) of Interest _____

ANNUAL DUES AND SUBSCRIPTIONS TO *BANISTERIA*

(memberships and subscriptions are by calendar year; subscribers/members outside the United States should add $3.00 for additional postage)

- ☐ $500.00 Life (not annual)
- ☐ $300.00 Benefactor
- ☐ $100.00 Patron
- ☐ $50.00 Supporting
- ☐ $40.00 Institutional
- ☐ $25.00 Family
- ☐ $20.00 Regular
- ☐ $5.00 Student (see below)
- ☐ I have added a contribution of $_____ to my membership dues.

The special student rate is applicable only when accompanied by the following certification signed by a faculty advisor (**students are also eligible for a 1-year free membership** if an advisor's nomination is approved by the society's Executive Committee; see nomination guidelines in *Banisteria*).

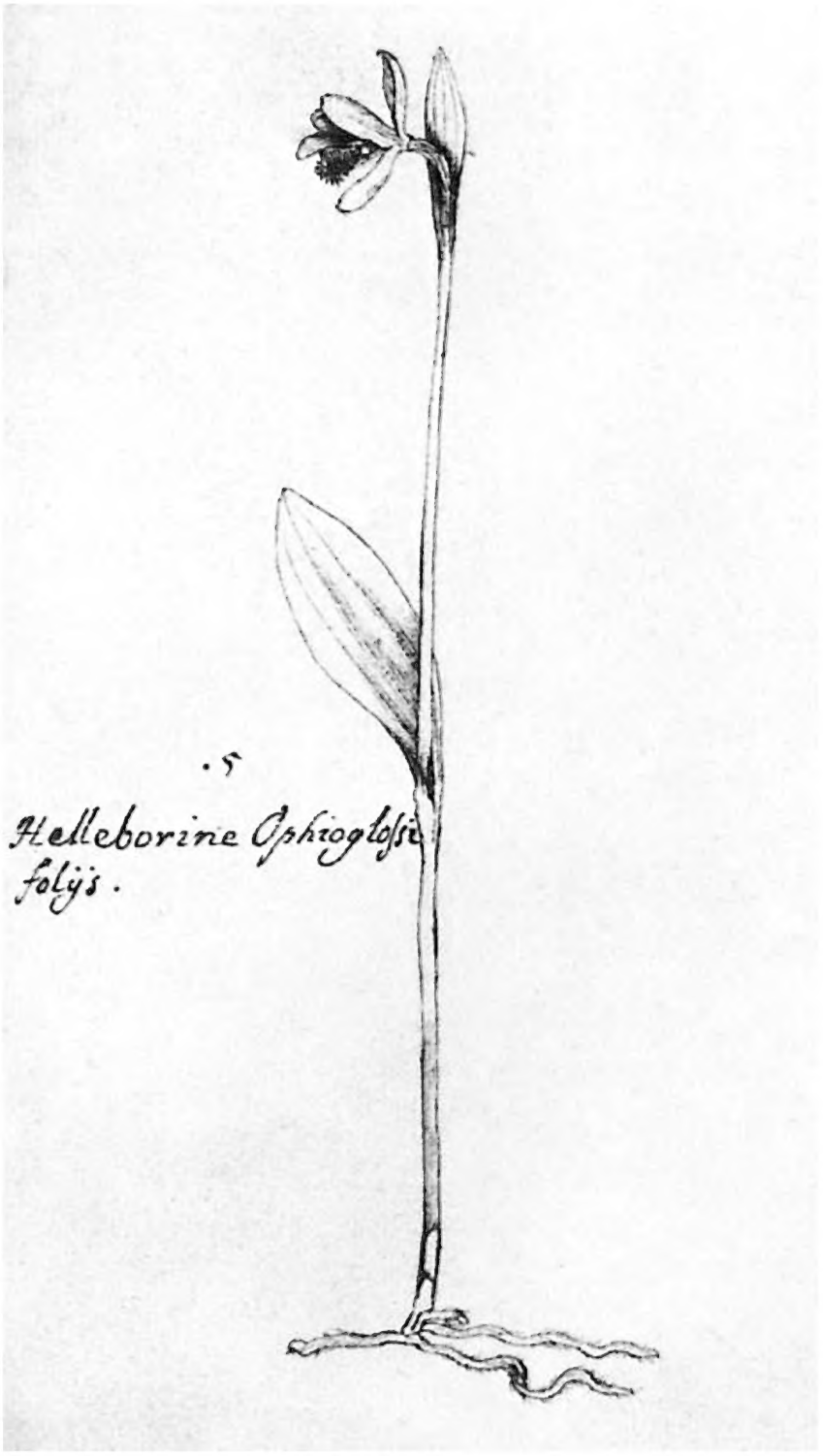
Institution _____

Advisor _____

Date _____

Make checks or money orders payable to:
Virginia Natural History Society

Send membership form and dues to:
Dr. Rachel Goodman, Secretary-Treasurer
Virginia Natural History Society
Box 74
Hampden-Sydney, VA 23943



·5

Helleborine Ophioglossi
foljs.